Railway Engineering Maintenance

STRENGTH *is* ECONOMY
WEIGHT *is* EXTRAVAGANCE

OUR RAIL JOINTS
ARE CHEAPEST PER
UNIT OF STRENGTH

— CONSULT —

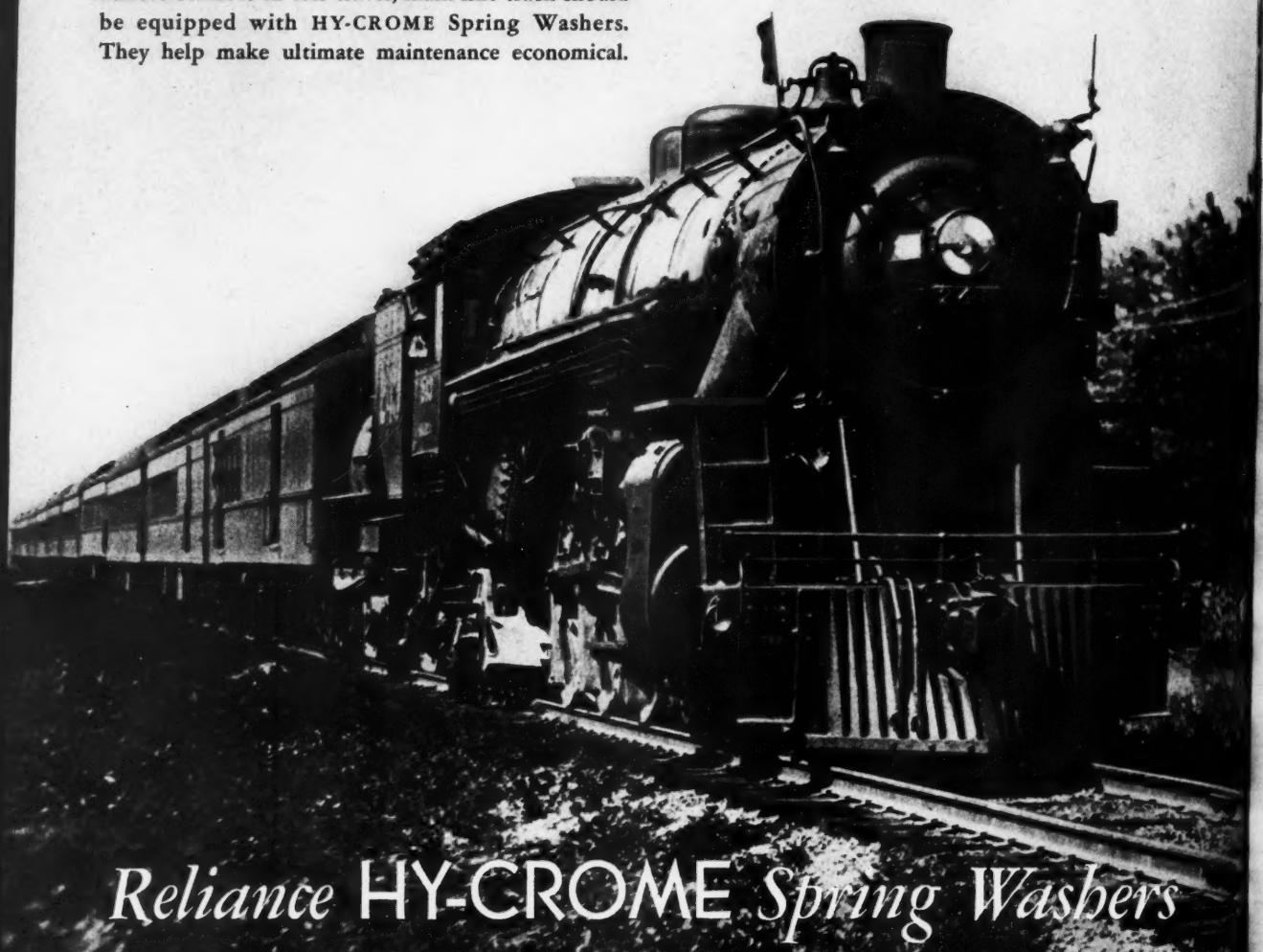
THE RAIL JOINT COMPANY

One of America's Famous Trains

ORANGE BLOSSOM SPECIAL

SEABOARD AIR LINE RAILWAY

OPERATING daily each winter season from December through April between New York, Washington, West Palm Beach, Miami, Tampa, St. Petersburg, Sarasota and Venice; serving all of the important Florida play-grounds, the ORANGE BLOSSOM SPECIAL is one of the most luxuriously equipped trains of the continent. Besides this, the Seaboard Air Line Railway operates four other trains daily, between New York and Washington and the southeast, serving the principal cities and capitals of Virginia, the Carolinas, Georgia, Alabama and Florida. All of these trains are completely air-conditioned. For utmost comfort in rail travel, main line track should be equipped with HY-CROME Spring Washers. They help make ultimate maintenance economical.



Reliance HY-CROME *Spring Washers*

REActive Deflected	THACKERAY	HY-REACTION	STANDARD	HEAVY DUTY	DOUBLE	BONDI
...ets A. R. E. A. Spec.	*For screw spike use*	*For track bolts*	*For general use*	*For frogs—crossings*	*For special use*	*Used as ra...*

HY-CROME

EATON MANUFACTURING CO. RELIANCE SPRING WASHER DIVISION, MASSILLON, OH...

Right in Step with MODERN TRANSPORTATION

LUNDIE TIE PLATE SERVICE is as conspicuously outstanding as is the performance of the new high-speed, smooth-riding streamliners. . . . For many years, more than 200,000,000 Lundie Plates have demonstrated an unusual ability to hold gauge and prevent spreading of track. They assure a stronger and safer track structure, free from mechanical wear, and help to maintain a refinement of surface so absolutely necessary for smoother and easier riding track at high speeds. . . . Lundie accomplishments are the direct result of its scientifically designed bottom, which has no sharp projections, does not cut a single tie fibre, prevents slipping and shifting and relieves the thrusts on the spikes. Lundie Tie Plates are made with single or double shoulders to comply with A.R.E.A. specifications or can be furnished to meet your own specifications.

THE LUNDIE ENGINEERING CORPORATION

Tie Plates—Ardco Rail and Flange Lubricator

19 West 50th St., New York 59 E. Van Buren St., Chicago

LUNDIE TIE PLATE

Published monthly by Simmons-Boardman Publishing Company, 105 W. Adams St., Chicago, Ill. Subscription price, United States and Possessions, and Canada, $3.00; Foreign $3.00. Single copies 35 cents. Entered as second-class matter January 20, 1933, at the postoffice at Chicago, Illinois, under the Act of March 3, 1879, with additional entry at Mt. Morris, Ill., postoffice. Address communications to 105 W. Adams St., Chicago, Ill.

MODERN EQUIPMENT REDUCES MAINTENANCE

Ingersoll-Rand Two-Stage Air-Cooled Tie Tamper Compressor equipped with Timken Bearings on the main shaft.

Modern equipment designed to do specific work speedily and efficiently at low cost is simplifying maintenance problems on American railroads.

In an overwhelming proportion of this equipment—wherever wheels and shafts turn — you'll find Timken Bearings eliminating friction and wear; carrying radial, thrust and combined loads; and holding moving parts in correct and constant alignment. No other type of bearing can give this complete and essential protection because there is no substitute for the exclusive combination of Timken tapered construction, Timken positively aligned rolls and Timken Alloy Steel.

As a result of the important part they play in assuring faster operation, greater dependability and longer equipment life, the presence of Timken Bearings is universally regarded as proof of modern-ness in any kind of equipment. Specify Timken-equipped.

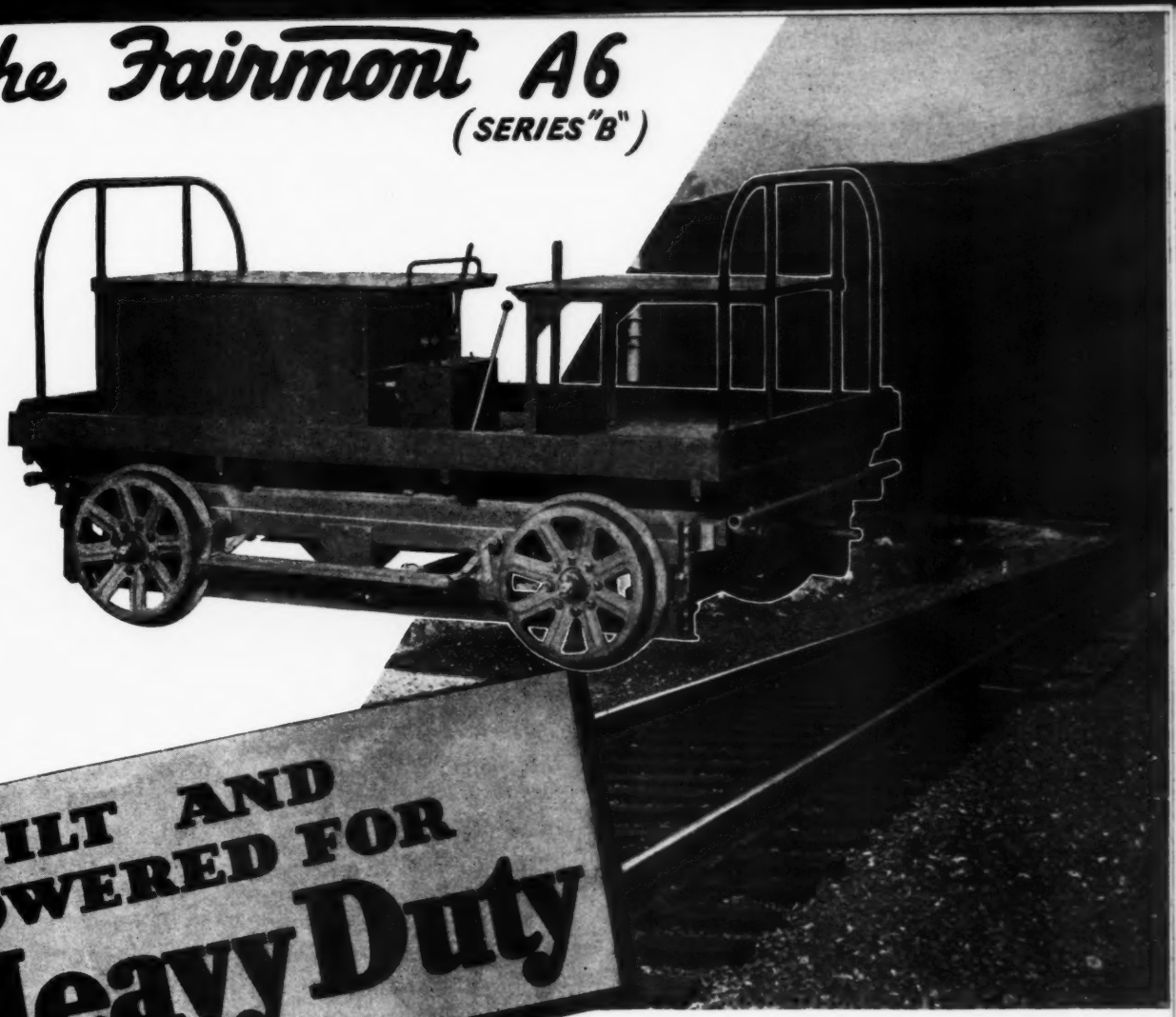
Tapered Roller TIMKEN BEARING EQUIPPED

A symbol of quality for any piece of equipment with which it is associated

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN TAPERED ROLLER BEARINGS

The Fairmont A6
(SERIES "B")



BUILT AND POWERED FOR Heavy Duty

● This new Fairmont car goes right to the front in the heavy duty field. It has power, design and body construction for every type of service demanding unfailing drawbar pull—discing, ballast dressing and hauling heavy trailers loaded with 200 to 240 men and equipment.

Because this car has an exceptionally long spring base and an engine mounted in rubber, the ride is so comfortable and the car is so commodious that it is frequently used by official inspection parties comprising 8 to 11 executives. Short lines also use this A6 Car in passenger service and in hauling light freight on stake body trailers.

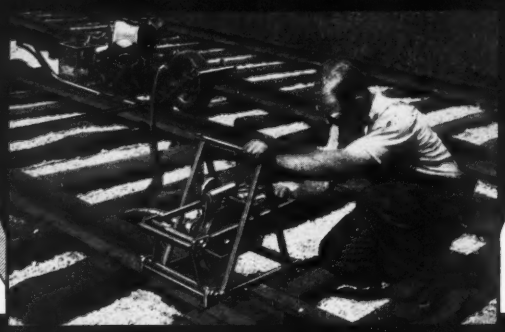
While this car combines rugged strength with ample seating and extra large tool space, the operating lift is held to 609 lbs. for easy handling. Dependable power is furnished by the Ford V-8 80 H. P. engine or the Ford Model "B" 4-cyl. 50 H. P. engine—and, in each case, three speeds both forward and in reverse make it unnecessary to turn the car on tracks for backing up or return trips. Fairmont Railway Motors, Inc., Fairmont, Minnesota.

Inspection Motor Cars . . . Section Motor Cars . . . B & B and Extra Gang Cars . . . Gas-Electric Ditchers . . . Shapers . . . Ballast Cleaners . . . Ballast Drainage Cars . . . Mowers . . . Weed Burners . . . Extinguisher Cars . . . Power Cars: Air, Electric, Paint Spray, Tie Tamping . . . Rail Coaches . . . Motor Car Engines . . . Push Cars and Trailers . . . Roller Axle Bearings . . . Wheels and Axles

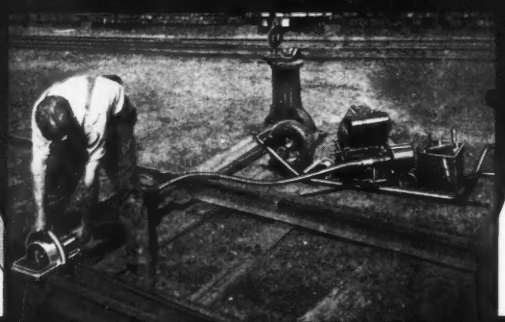
Performance ON THE JOB COUNTS

Fairmont

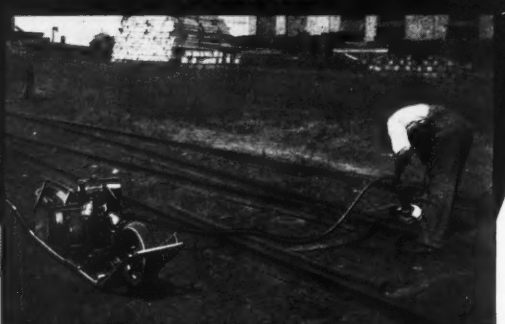
Wherever Rail Grinding is Done



Slotting joints with guide gives greater accuracy and speed.



Cup wheel removing flow at switch points and stock rails.



One of the many jobs to be done with freely held wheel.

Precision Grinder

This new grinder is the latest contribution of Nordberg to track maintenance. Its cup wheel not only cuts fast but attains a precision equivalent to tool room grinding. The design is one that affords the essentials of speed, accuracy and ease to the operator, not found in any other rail grinder. For finish grinding after welding, or for removing mill tolerance, it meets today's demands for better track for high speed traffic.

Utility Grinder

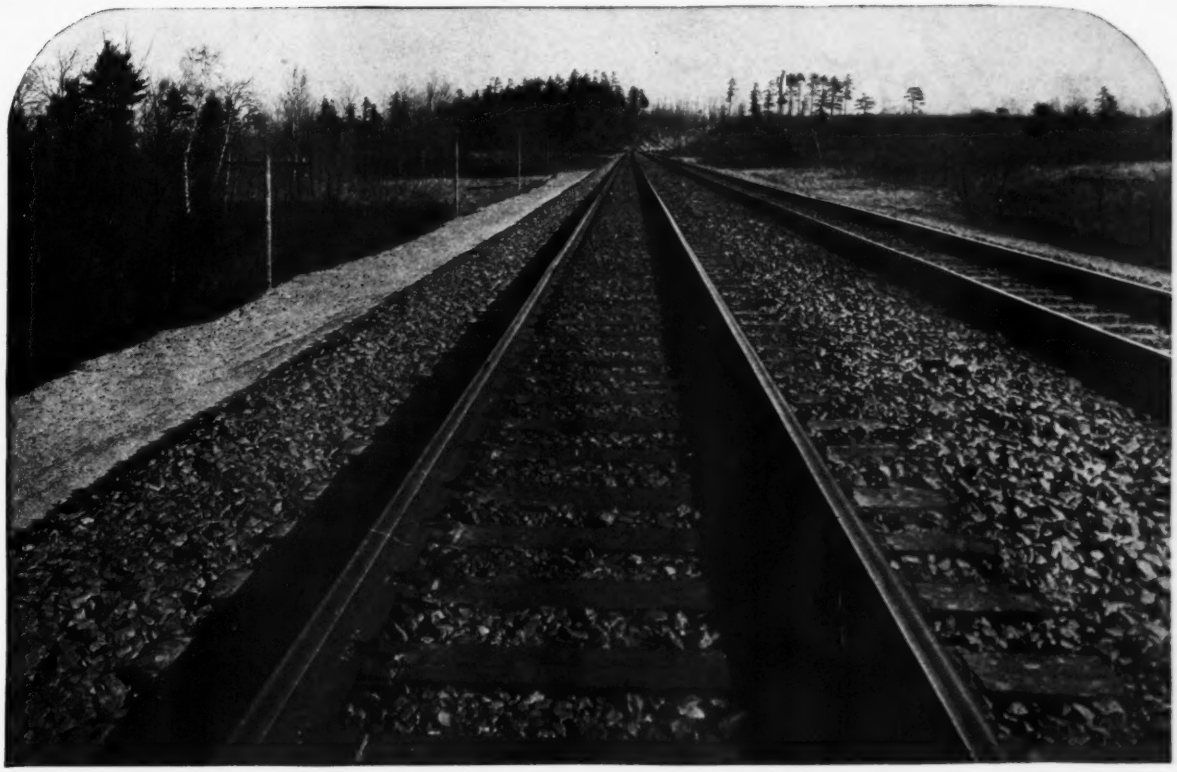
There are so many uses to which this grinder can be put, and with the various attachments developed by Nordberg, it is truly an all-purpose grinder. Slotting joints, grinding switches, frogs and crossings and boring holes for screw spikes, are only some of its uses. Here is a tool that can be kept busy throughout the year, saving money and doing each job better.

THE OTHER NORDBERG TRACK TOOLS

Adzing Machine	**Track Wrench**
Spike Puller	**Power Jack**
Rail Drill	**Track Shifter**

NORDBERG MFG. CO.

MILWAUKEE, WIS.



A Direct Route
TO TREMENDOUS SAVINGS

Twelve thousand feet of track, Thermit welded into one continuous stretch, except for a single pair of insulated joints, are shown in this picture.

Installations such as this are pointing the way direct to enormous savings. Long welded rails have no gaps for wheels to pound; no rail ends to batter. Joint maintenance is banished because the joints themselves are eliminated. Frequent track lining and surfacing become unnecessary. Rail life is increased. Wear and tear on rolling stock and motive power are reduced.

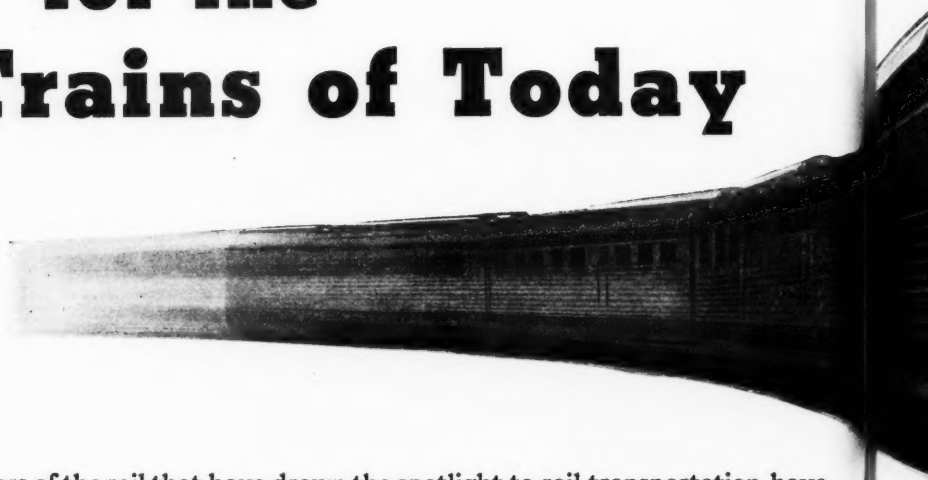
Nor, is there any doubt about continuous rails behaving satisfactorily under varying conditions. A number of long jointless stretches are now in service on main line track. Some are on straightaways, some on curves, some level and some on grades. Several installations have been giving good service for almost three years through repeated temperature changes as great as 150° Fah. On the Delaware & Hudson, welded rails have been installed with M. & L. construction; on the Bessemer & Lake Erie, with GEO.

It will pay you to investigate. Write now for information, or, ask to have our nearest representative call and give you the complete story.

METAL & THERMIT CORPORATION, 120 BROADWAY, NEW YORK, N.Y.
ALBANY • CHICAGO • PITTSBURGH • SO. SAN FRANCISCO • TORONTO

THERMIT *Rail* WELDING

Better, Smoother Track for the Fleet Trains of Today



THE LITHE, fleet coursers of the rail that have drawn the spotlight to rail transportation have focused more attention than ever before on track maintenance.

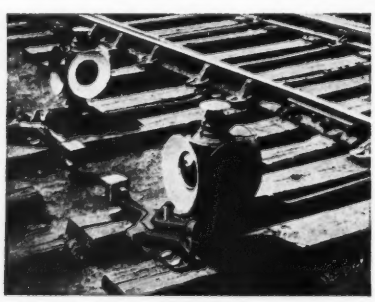
The entire line of Bethlehem Track Accessories is attuned to the demands of this era of increasingly swift movement of all classes of rail traffic. They help to provide the precision of track structure essential to smooth riding of fast, light-weight equipment. At the same time they are built with the rugged strength and resilience to bear up under the multitude of fast-rolling, heavily-laden wheels of freight trains that vie with passenger trains for speed honors. Provision is made for adjustment wherever it will simplify the work of keeping track tuned up.

Leading items of Bethlehem Track Equipment are described briefly herewith. Literature giving more detailed information is available on request.

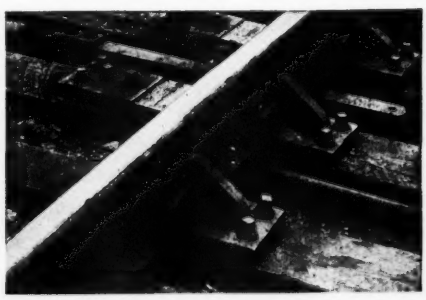
Bethlehem Hook-Flange Guard Rail cushions shocks—spares wheel flanges. The Bethlehem Hook-Flange Guard Rail straightens up fast-moving trucks without great shock, saving wear and tear on both guard rail and wheel flanges.

It's the rolled-steel construction of this guard rail that fits it for today's severe service. It yields slightly, dissipating the impact. This guard rail is the safe one for high-speed main-line track.

The New Century Switch Stand measures up to the heaviest main-line switches. The New Century Switch Stand is built to a design proved fundamentally sound through service on leading railways over a period of more than forty years. It has been continually strengthened and improved as the demands upon switch stands have become more severe. Parts made of heat-treated alloy steel provide rugged strength well ahead of present-day requirements.

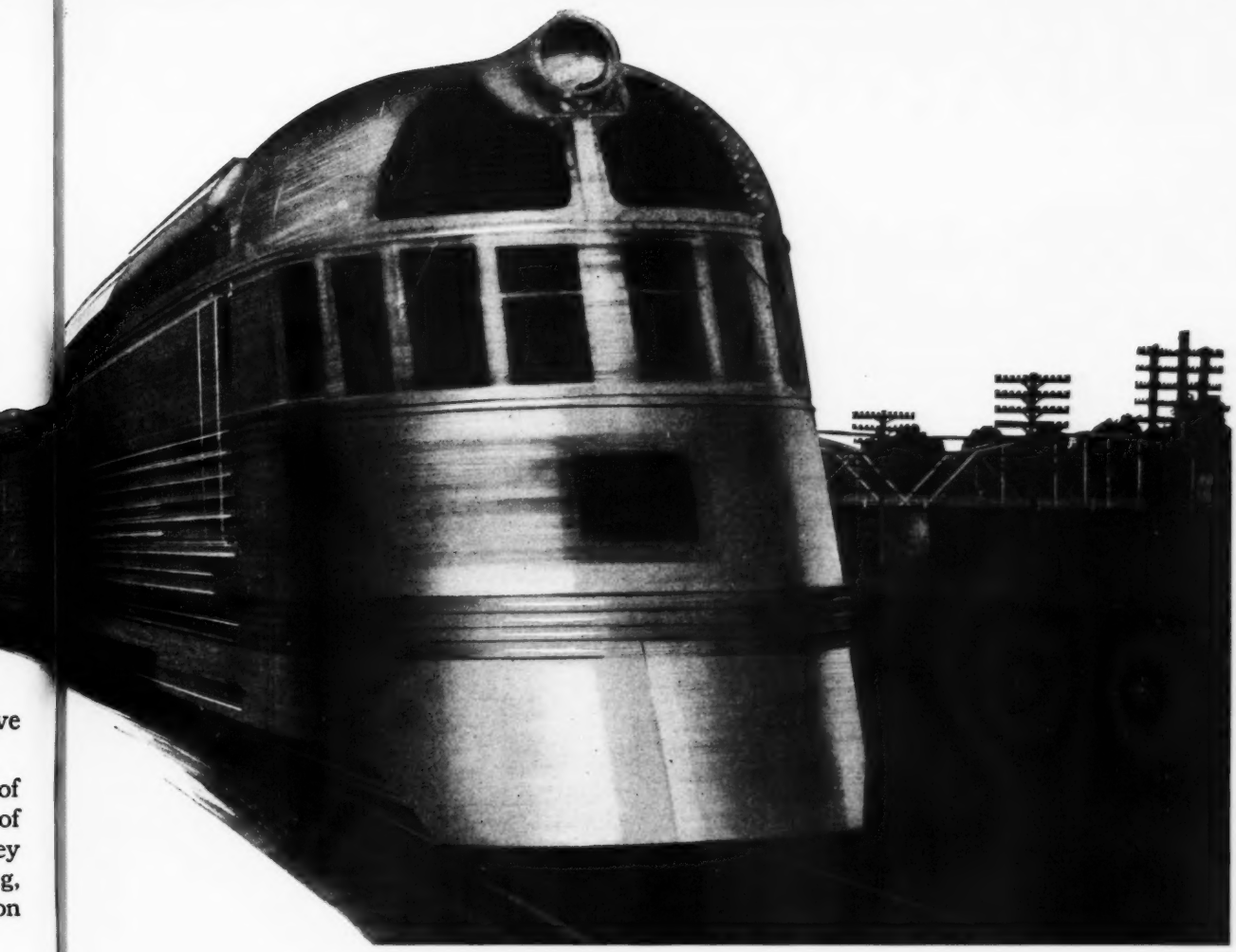


Bethlehem makes other switch stands equally well suited to their fields of service. Among them is Model 1222, an ideal stand to use in yards where sorting and train-make-up requirements call for a stand that can be operated quickly and easily.

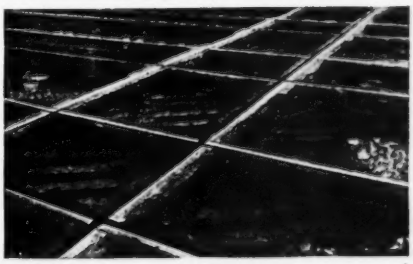


Bethlehem Spring Rail Brace provides effective, resilient bracing at turnouts. The Bethlehem Adjustable Spring Rail Brace securely anchors rails against side thrusts. It yields slightly under impact, cushioning shocks, and recovering instantly. The adjustable feature simplifies the work of holding track accurately.

This rail brace is of two-piece construction—a combined switch plate and brace and a spring wedge. It is easily installed and readily adjusted in steps of $\frac{1}{16}$ in. by means of a pawl and slot arrangement, the only tool required being a hammer. The spring, besides providing the resilience to absorb impacts, maintains constant pressure on the rail, preventing vibration from loosening the wedge.



Bethlehem Heat-Treated Crossings reduce maintenance. Bethlehem Heat-Treated Crossings were developed to meet the needs of railroading today. Made of heat-treated rolled steel, these crossings have the combination of strength and resilience needed to stand the pounding of the fast-rolling wheels encountered nowadays. These crossings effectively lower maintenance expenses wherever traffic conditions are rigorous.



Bethlehem Positive Signal Stand raises safety standards. This safety device hooks up the switch points with a distant signal to give warning of any dangerous conditions at the switch.

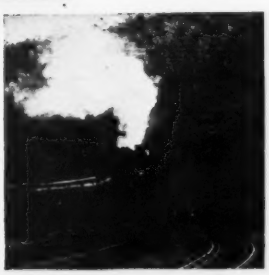
For today's speeds the Bethlehem Positive Signal Stand is a highly desirable supplement to railroad signal equipment. With this stand any switch in track-circuit territory, however remote, can be made as safe as one controlled from an interlocking plant.

The design of this device permits easy installation and ready accessibility for adjustment or inspection. The total assembly is so compact it occupies little more space than the average switch stand.

Bethlehem Gage Rod stabilizes the rail at curves. Bethlehem Gage Rods are the appropriate means of balancing the extra-severe thrusts at curves and switch toes resulting from greater speeds.

These gage rods distribute the thrust over both rails at curves and keep the rails to gage and in precise alignment.

The use of Bethlehem Gage Rods will be found to be an effective means of economizing on track maintenance.

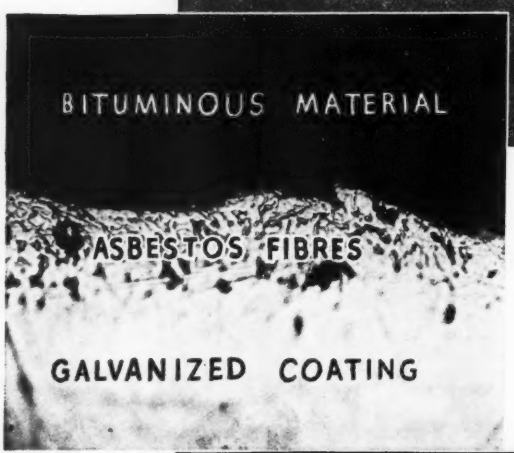


Bethlehem Twin Frog Plates eliminate use of special plates. Bethlehem Twin Frog Plates come in standard 23-in., 26-in. and 28-in. sizes to fit any size frog and any frog angle.

These plates are made of rolled steel with a forged hook that is heavier than a track spike. This hook fits over the base flange of the frog, holding it securely in position under severest service conditions. Each plate is punched to receive five track spikes.

BETHLEHEM STEEL COMPANY

NOW... An Improvement THAT INSURES A HIGH



Left: Notice how the deeply-embedded asbestos fibres bind the bituminous material to the pipe, as shown by this photomicrograph (highly magnified). Remember, too, that asbestos is absolutely non-deteriorating.

Here's the new Asbestos Bonded Armco Paved Invert Pipe. Developed especially for severe service, its superior strength and greatly increased durability insure a high degree of permanence for all railroad drainage purposes.

ARMCO

ASBESTOS BONDED

ARMCO PAVED INVERT PIPE

in Corrugated Metal Pipe

DEGREE OF PERMANENCE

● Ten years of service has already proved the value of putting a *smooth* bituminous pavement in the bottom of corrugated metal pipe. Moreover, in practically all of the structures inspected, these pavements are giving complete protection to the underlying metal.

However, Armco engineers have been constantly striving to improve this product, to make it serve your needs still better. And now, after many years of experimental and research, they have found the answer—in an entirely new process, called *Asbestos Bonding.*

Here's what it is briefly. As the flat Armco Ingot Iron sheets emerge from the galvanizing rolls, a layer of asbestos felt is firmly embedded in the molten zinc coating. After the zinc hardens, the outer surface of these asbestos fibres is completely saturated with a special bituminous material. As a result, when the finished pipe is paved and coated in the usual way, there is a permanently tight bond between the bituminous coating and the pipe.

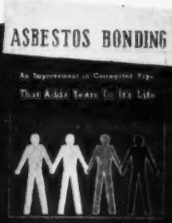
In addition, tests show that *Asbestos Bonding* actually widens the plastic range of the coating *as much as 50 per cent.* This provides an extra factor of safety, especially in storing and handling the pipe. Moreover, with these two improvements—enduring adhesion plus a wider plastic range—it is obvious that the service life of the pipe will be greatly increased. Remember, too, that *Asbestos Bonded* Armco Paved Invert Pipe insures a *structure* that will last as long as the *material.*

There's a new bulletin—just off the press—that tells you many of the things you will want to know about this modern pipe. Mail the coupon for your free copy. Ingot Iron Railway Products Co., Middletown, Ohio; Berkeley, California. (Member of the Armco Culvert Mfrs. Assn.)
Philadelphia • St. Louis • Salt Lake City • Los Angeles
Minneapolis • Houston • Portland • Atlanta • Denver
Chicago • Dallas • El Paso • Spokane • Richmond
Sidney, Montana,

★ ★ ★

This view shows you the tough, resilient surface of a finished sheet, after the asbestos felt binder has been applied and completely saturated with the bituminous primer. This surface is unaffected in making the pipe and it insures lasting adhesion with the bituminous pavement and coating.

FREE



Please send me your free bulletin describing *Asbestos Bonded* Armco Paved Invert Pipe.

*Name*_____

*Title*_____

*Address*_____

*City*_____

REM-5-2

How [AR] EQUIPMENT

Cuts Operating Costs

Do Not Overlook

These Opportunities to Increase Net Earnings

23% more air and 25% to 65% lower fuel costs per foot of air are reasons why I-R two-stage, air-cooled compressors will save money. These compressors are built in various capacities and with different modes of transport to meet all known requirements.

The MT-3 Low-air Consumption Tie Tamper, the most powerful tie tamper, uses 24% less air. It produces 33⅓ per cent more work for the same amount of air or fuel consumed.

I-R MT-3 Tie Tampers and I-R Two-Stage, Air-cooled Air Compressors have effected savings ranging from $233 to $2539 per tamping season of 100 working days. Their use has increased gang efficiency and their powerful high pressure blows produce sounder roadbeds.

I-R Impact Wrenches have reduced by 72 per cent the bolting up time on bridge work. These powerful wrenches draw the plate together so tightly that a loose rivet is rarely found.

And now we offer this handy, light-weight Spottamper for all-around utility and economy. Light in weight and easy to transport, the Spottamper is used to supplement the work of the larger compressors for light resurfacing and for building up low joints and low spots in track. It will operate 2 MT-1 or 2MT-2 or 4 MT-3 tie tampers with great effectiveness and can be used economically to operate the various pneumatic tools for track, bridge and building work.

For complete information on the Spottamper and the complete line of I-R compressors and pneumatic track tools write to any of our district offices.

Birmingham
Boston
Buffalo
Butte
Chicago
Cleveland
Dallas
Denver
Detroit
Duluth
El Paso
Houston
Knoxville

Ingersoll-Rand

11 BROADWAY, NEW YORK

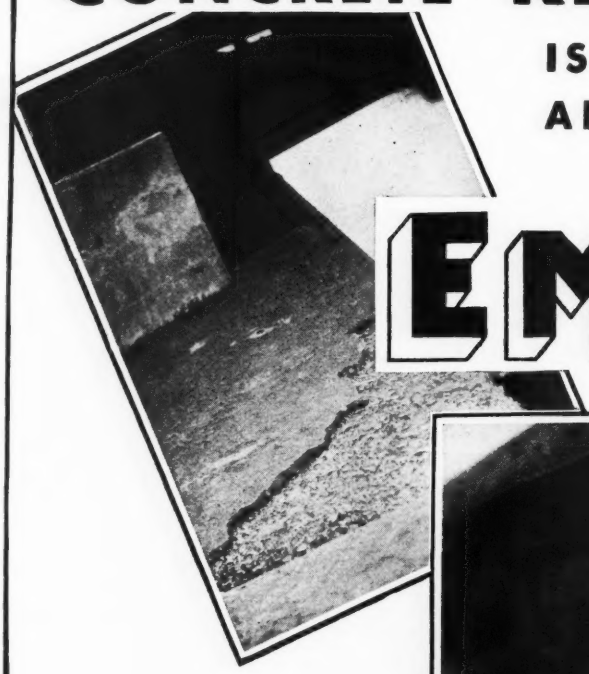
293-11

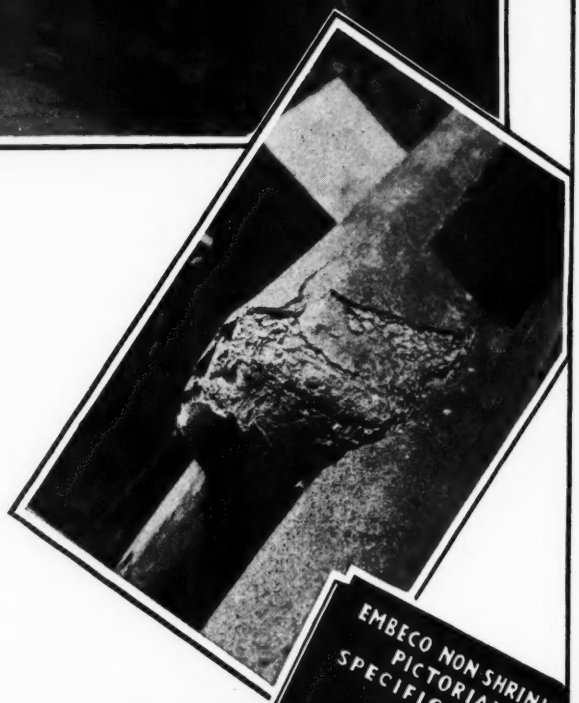
Los Angeles
Newark
New York
Philadelphia
Picher
Pittsburgh
Salt Lake City
San Francisco
Scranton
Seattle
St. Louis
Tulsa
Washington

CONCRETE REINTEGRATION

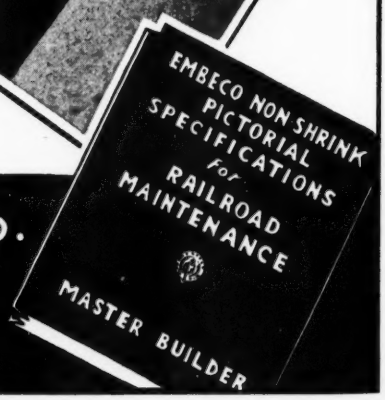
IS EASY . . ECONOMICAL AND ENDURING WITH NON-SHRINK

EMBECO





● Everywhere . . . on every right-of-way engineers are planning important concrete reintegration jobs. Everywhere . . . for big or little jobs, NON-SHRINK EMBECO is the choice of engineers who know the "proved performance" record of EMBECO! In the past decade EMBECO has earned the hearty respect of men charged with the responsibility of holding down maintenance costs . . . for EMBECO repairs stay repaired . . . EMBECO installations are easy, economical, enduring! Write now for full information . . . EMBECO *can save you time, money, trouble!*



THE MASTER BUILDERS CO.

CLEVELAND, OHIO

TORONTO, ONTARIO

Investigate these Plus Values IN BARCO TYTAMPERS

Barco Unit Tytampers represent not only the latest development in tamping equipment but also *extra values* that provide additional efficiency and economy in tamping.

They are portable. This means increased speed and decreased expense in transportation . . . Being self-contained units, expensive heavy auxiliary equipment is not required . . . They have plenty of power for any tamping requirements and will keep pace with heavier and more expensive equipment . . . Operating at a cost of about fifteen cents per hour, including fuel, occasional renewal of a battery, spark plug and springs, they provide the utmost in economy.

Barcos are equally efficient for tamping in gangs or for spot tamping. Because of their power and ease of handling they enable their operators to maintain a fast working pace.

BARCO MANUFACTURING COMPANY
1805 W. Winnemac Avenue,
Chicago, Illinois

THE HOLDEN CO., LTD.
In Canada
Montreal—Moncton—Toronto
Winnipeg—Vancouver

BARCO UNIT TYTAMPER

No. 89 of a series

Railway
Engineering and Maintenance

SIMMONS-BOARDMAN PUBLISHING COMPANY

105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: TWENTY-FIVE YEARS

April 30, 1936

Dear Reader:

We are celebrating two birthdays this month. On May 19, 1911, we first greeted you with the Maintenance of Way Section of the Railway Age, a 24-page addition to the third issue of each month of that weekly publication. Five years later, this section was launched as an independent publication, which you have come to know as Railway Engineering and Maintenance.

In announcing this specialized service for you in 1911, we stated that our purpose would be to promote economy and efficiency in the conduct of maintenance work. "The time has come," we said, "when the engineering and maintenance of way departments recognize that they have less to hope for in the future from reductions in grade and other major improvements of that character and more to gain from the smaller and less striking but more numerous improvements in the details of their work. No technical publication has heretofore given adequate study and attention to these more detailed matters. It will be the function of this section to do this. The most effective way in which the Maintenance of Way Section can serve railway officers is by constituting itself as a clearing house for new ideas regarding engineering and maintenance work."

In the quarter century that has elapsed, we have endeavored to make Railway Engineering and Maintenance a clearing house, through which we could bring to all of you collectively the ideas which you develop individually. In this quarter century machines have been perfected to take much of the drudgery from maintenance work; newer and better materials have replaced those of shorter life and more archaic design. Maintenance practices have become among the most efficient in the railway industry. Throughout this period we have seen the roadway properties raised to the highest standards in the history of American railways — standards that have enabled the tracks and structures to withstand five years of grossly subnormal expenditures with surprisingly little evidence of distress.

Such records reflect your alertness in seeking and accepting new ideas. And we hope that we may, with modesty, lay claim to a little of the credit for these improvements by keeping the spotlight on improved practices throughout these years. I take pride in the fact that it has been my privilege to direct the editorial program of Railway Engineering and Maintenance from its inception.

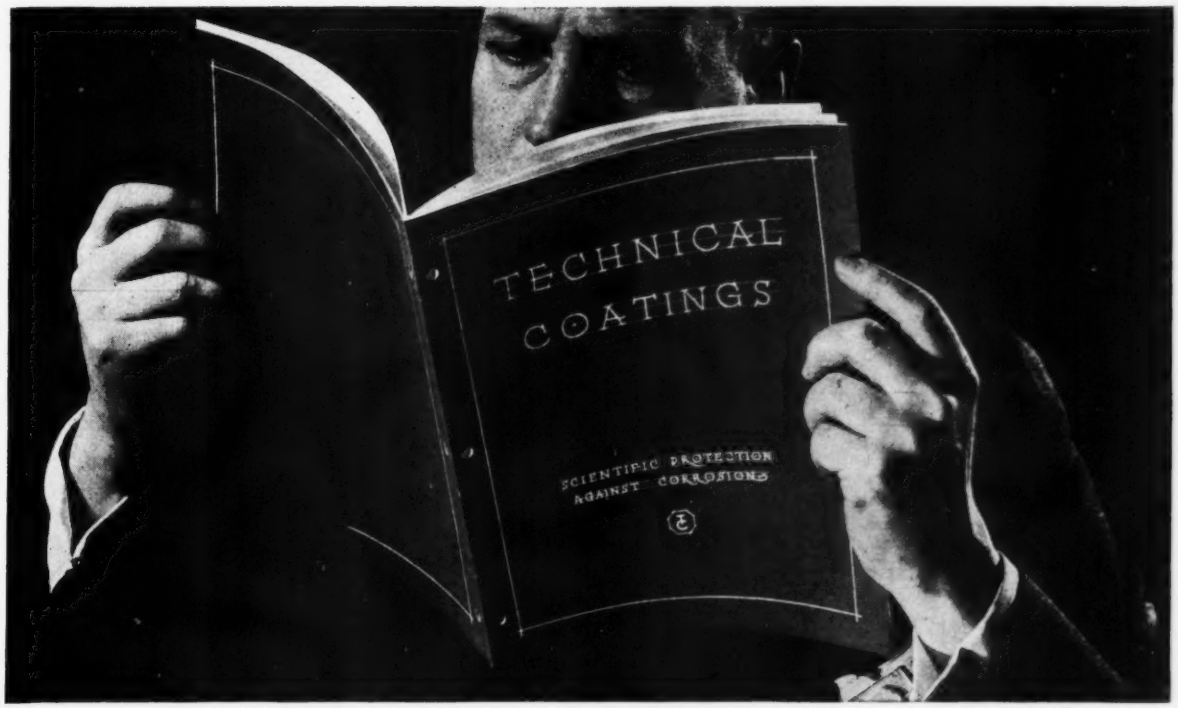
Yours sincerely,

Elmer T. Howson

ETH:EW

Editor

MEMBERS: AUDIT BUREAU OF CIRCULATIONS AND ASSOCIATED BUSINESS PAPERS, INC.



CORROSION LOSS REDUCED

New Technical Coatings resist destructive elements with greater efficiency

• A group of engineering executives wanted relief from heavy corrosion losses. They endowed a research program at one of America's leading scientific institutes, to develop an efficient anti-corrosion surfacer. The result was an absolutely non-porous liquid, which is used as the base for the new Technical Coatings. These products achieve unprecedented efficiency in use on wood, metal and concrete surfaces.

Rigorous tests have been made of Technical Coatings by prospective buyers—90% of the testers become steady users, and find them more durable and economical than any surfacer they ever used. Technical Coatings provide increased durability and great savings of time and labor, with complete protection of exposed surfaces from corrosion.

How your company can save money by reducing corrosion damage is told in the book, "Technical Coatings," written for maintenance and purchasing executives. A copy will be sent you, without obligation. Technical Coatings, Inc., 11 Park Place, New York, N.Y.

Executives SEND FOR THIS BOOK. IT WILL SAVE YOU MONEY. *Write today*

Better Protection for Structural Materials

1. Non-porous vehicle.
2. Perfect Adhesion.
3. Air-tight.
4. Water-tight.
5. Brine-resistant.
6. Oil-proof.
7. Greater elasticity.
8. Will not chip, peel, or crack.
9. Proved by rigorous testing.
10. Line of primers, topcoats, colors.

R-1

TECHNICAL COATINGS, INC.
11 Park Place, New York, N. Y.

Without obligation, send us the book, "Technical Coatings."

Firm.....

Address.....

City..... State.....

Attention of.....

OXWELDING
Saves Angle Bar Replacement

Oxweld MW Welding Rod
gives angle bars a wear-resistant surface.

● Angle-bar welding by the oxy-acetylene process is saving thousands of dollars annually for the railroads. This process provides a made-to-order fishing surface. Building-up the bars with highly wear-resistant Oxweld MW welding rod to a surface slightly higher than the original compensates for wear on the under side of the rail head.

This work can be done on line of road where track is being brought to line and surface, or bars can be shipped to a central point for rebuilding.

The Oxweld Railroad Service Company is in a position to assist its railroad clients in organizing this type of maintenance-of-way work, in the field or shop, for the greatest possible savings.

THE OXWELD RAILROAD SERVICE COMPANY
Unit of Union Carbide and Carbon Corporation

NEW YORK:
Carbide and Carbon Bldg.

UCC

CHICAGO:
Carbide and Carbon Bldg

OXWELD RAILROAD SERVICE

The bolts are cut off with the cutting blowpipe, and about fifty bars are removed.

Rebuilt-to-order bars are bolted in place replacing the ones removed for welding.

Typical welding set-up along the right-of-way.

The height of the bar is measured with a straight-edge after welding is completed.

Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

Published on the first day of each month by the

SIMMONS-BOARDMAN PUBLISHING COMPANY

105 West Adams Street, Chicago

NEW YORK
30 Church Street

CLEVELAND
Terminal Tower

WASHINGTON, D. C.
932 National Press Bldg.

Samuel O. Dunn, *Chairman of the Board*; Henry Lee, *President*; Lucius B. Sherman, *Vice-President*; Cecil R. Mills, *Vice-President*, Roy V. Wright, *Vice-President* and *Secretary*; Frederick H. Thompson, *Vice-President*; Elmer T. Howson, *Vice-President*; F. C. Koch, *Vice-President*; John T. DeMott, *Treasurer*.

Subscription price in the United States and Possessions, and Canada, 1 year $2, 2 years $3; foreign countries, 1 year $3; 2 years $5. Single copies, 35 cents each.

Member of the Associated Business Papers (A.B.P.) and of the Audit Bureau of Circulations (A.B.C.).

May, 1936

Editorials - **287**
Recognition—Rail Orders—Progress

Patrols Replace Track Walkers - - - - - - - - - - - - - - - **290**
New York, New Haven & Hartford has adopted a new system of track inspection that has resulted in substantial economies

Inspecting for Bolt-Hole Breaks - - - - - - - - - - - - - - - **293**
C.H.R. Howe calls attention to the high cost of inspection and discusses considerations determining the necessity for it

Rail Production Statistics - - - - - - - - - - - - - - - - - **294**
Output in 1935 was 711,537 gross tons, compared with 1,010,224 tons in 1934, 416,296 tons in 1933 and 402,566 tons in 1932

Underpins Old Masonry Pier - - - - - - - - - - - - - - - - - **295**
How the substructure of a bridge on the Canadian National was repaired in the face of serious difficulties

The Lime-Soda Ash Process - - - - - - - - - - - - - - - - - **299**
A review of the development of this method of treating water and a description of the types of equipment now in use

Surfacing Out-of-Face - - - - - - - - - - - - - - - - - - - **301**
Robert Herald describes a method of reducing the cost of this important maintenance function to a minimum

Prolonging the Life of Rail - - - - - - - - - - - - - - - - - **302**
C. B. Bronson lists five principal causes of deterioration and discusses the means for overcoming the damage done

What's the Answer - **306**

New Products of the Manufacturers - - - - - - - - - - - - - **313**

News of the Month - **314**

ELMER T. HOWSON
Editor

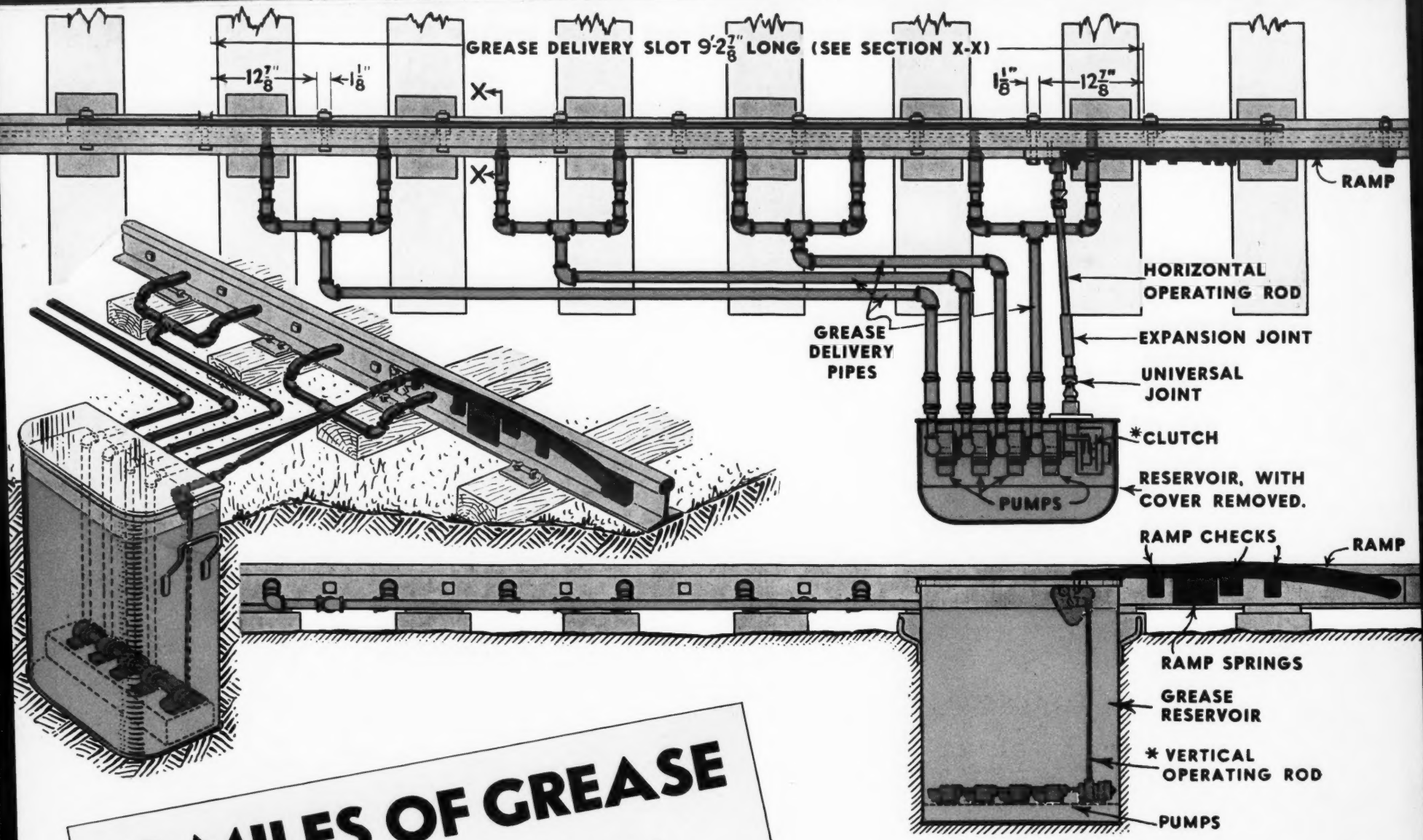
WALTER S. LACHER
Managing Editor

NEAL D. HOWARD
Eastern Editor

GEORGE E. BOYD
Associate Editor

M. H. DICK
Associate Editor

F. C. KOCH
Business Manager



10 MILES OF GREASE *with*

* NOTE — VERTICAL OPERATING ROD OPERATES GEAR PUMPS ON SPRING ACTUATED LIFT MOTION ONLY.

ROD OPERATES GEAR PUMPS ON SPRING ACTUATED LIFT MOTION ONLY.

the RACOR RAIL LUBRICATOR

Extensive tests over a period of years have demonstrated that the Racor Rail Lubricator will protect curves as far as ten miles from its point of installation without wasting the lubricant on tangent track.

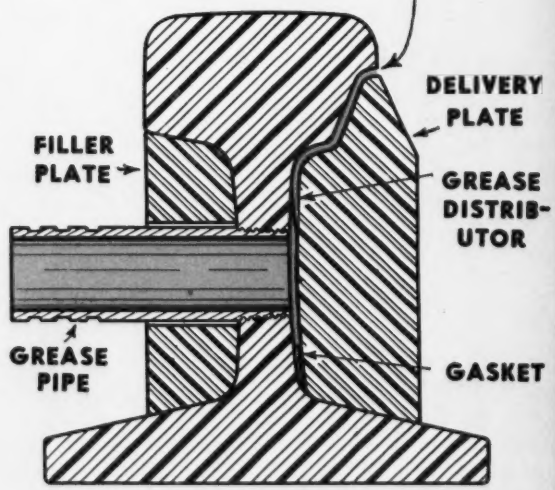
Here's How It Works

Four gear pumps, actuated by a ramp, deliver the lubricant through eight grease pipes to the chamber between the delivery plate and the rail, shown in section X-X.

Distributors on the delivery plate deflect the lubricant so that it is forced out of the delivery slot in a continuous line. The grease is thus picked up by the side of the flange in such a manner that the flange retains the maximum amount of lubricant on the surface coming in contact with the high rail of a curve and a minimum amount is wasted.

The operating parts of the Racor Rail Lubricator are of substantial construction, with flexible connections, and require only periodical inspection to see that the grease reservoir is filled and the few operating parts exposed to the weather are kept oiled.

GREASE DELIVERY SLOT 9'-2⅞" LONG DIVIDED INTO 8 DELIVERY SPACES (EACH 12⅞" LONG) BY SHIMS AT BOLTS WHICH MAINTAIN THE WIDTH OF DELIVERY SLOTS ACCURATELY.



SECTION X-X

RAMAPO AJAX CORPORATION

RACOR PACIFIC FROG AND SWITCH COMPANY

CANADIAN RAMAPO IRON WORKS, LIMITED

RACOR TRADE MARK

General Offices
230 PARK AVENUE, NEW YORK

Racor Works

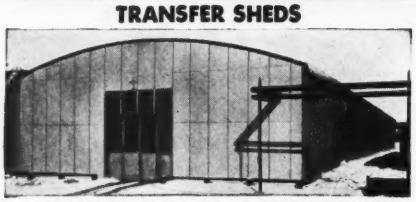
CHICAGO, ILL.
EAST ST. LOUIS, ILL.
HILLBURN, NEW YORK
LOS ANGELES, CALIF.
NIAGARA FALLS, N. Y.
NIAGARA FALLS, ONT.
PUEBLO, COLO.
SEATTLE, WASH.
SUPERIOR, WIS.

THE KIND OF BUILDING YOU WANT

AS YOU WANT IT

AND WHEN YOU WANT IT!

TRANSFER SHEDS

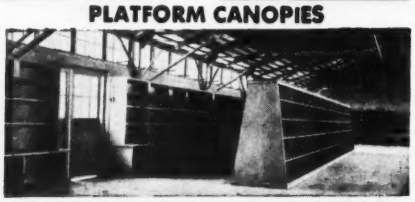


PERISHABLE FOOD WAREHOUSES

SHOP BUILDINGS

BUNK HOUSES

PLATFORM CANOPIES



STORES DEPARTMENT BUILDINGS

THAT'S THE KIND OF SERVICE

TRUSCON

OFFERS THE RAILROADS

Proper approach to railroad building problems is this: Get all facts about Truscon Standard Buildings. Get all facts about any comparable permanent structures. Compare facts. Then judge.

Space forbids enumeration of ALL facts about Truscon Standard Buildings on this page. But here are a few:

Kind of building you want can be matched exactly by selection of correct units available for prompt shipment by Truscon.

As you want it means that you can have any size, any arrangement of steel doors and windows, any type of steel side walls, any type of steel roof . . . flat, pitched or monitor. Thus, firesafety is added to structural strength and permanence.

When you want it means that . . . regardless of weather or location . . . your workmen or ours or both can erect a Truscon Standard Building in the shortest possible time compared to any other type of permanent construction.

AND NOW . . . due to a recent development . . . every Truscon Standard Building is equipped with a base panel of ENDURO Stainless Steel to insure 100% protection against rust and corrosion at the foundation line.

One of the many additional facts of importance is the ease of dismantling Truscon Standard Buildings and re-erecting them in new locations with practically 100% salvage value.

TRUSCON-FHA terms make it convenient to spread payments over a period of time that is often adequate to make the building *pay for itself* in savings on maintenance and profits on the investment.

FOR QUICK ANALYSIS of ALL the facts, CALL TRUSCON at any one of our 52 strategically located sales and engineering offices, or write direct to:

TRUSCON STEEL COMPANY YOUNGSTOWN, OHIO

Railway Engineering and Maintenance

Recognition

The Newspapers Wrote This Editorial

THE newspapers are the best available index of public thought. They reflect and crystallize opinion in their communities. Nowhere else can one secure a more accurate cross section of the attitude of the people at large on any topic.

The last three months have been a period of unusual difficulties for the railways. In large areas they were forced to battle snow and cold of unprecedented severity and duration. Scarcely had this condition passed when they were ravaged by floods of great destructive effect.

Does the Public Know?

These forces of nature placed tremendous burdens on the railways—and especially on their maintenance of way forces, as the readers of *Railway Engineering and Maintenance* well know. That they have met these crises with credit is recognized throughout the railway industry. But are these achievements known and appreciated by those outside the railways—those who form public opinion and those upon whose good will and patronage the railways are dependent for their very existence?

For the answer to this question, we turn to the newspapers—the index of public thought. We shall quote from newspapers in large and in small communities—serving areas as far east as Great Neck, Long Island, and as far west as Bend, Ore.; as far north as Glendive, Mont., and Bangor, Me., and as far south as Greenville, S. C. These quotations show the extent of the public appreciation of the service that the railways are rendering in these days when they are being subjected to competition from so many directions.

The Philadelphia (Pa.) Inquirer of February 8, commented editorially as follows:

> Traffic difficulties caused by the storm which has held in its icy grip the vast territory between the Mississippi river and the Atlantic seaboard and from the Canadian border to the Carolinas emphasize the fact that the railroads, except for minor dislocations, have uninterruptedly maintained their services. Icy roads and streets have brought peril to motorists and only the more adventurous have driven during the past two days. Buses have skidded and slithered, sometimes over embankments, endangering the lives of occupants. The railroads have gone on steadily transporting greatly increased numbers of passengers, for the most part with a minimum of delay and inconvenience.
>
> In crises, as at no other times, the railroads demonstrate their all-around supremacy in transportation service. They merit consideration instead of abuse, at the hands of government agencies.

Under the heading "Fair-Weather Friends," the Cavalier County Republican of Langdon, N. D., described conditions in the northwest, in part as follows:

> The railroads in the northwest spent four million dollars extra in serving the towns and people of this section this winter as well as was humanly and mechanically possible. All this money was spent while our "fair-weather" friends, the trucks and buses, sat idly by waiting for tax-payer-owned snow equipment manned by tax-payer-paid workers to open the highways, usually even laying off their employees until their labor could be employed at a profit.
>
> The Dakota division of the Great Northern operated as many as a dozen plows and dozers at a time, each one double-crewed, with work progressing day and night during a large part of February as well as times during January and December. Many employees suffered frozen faces and limbs in trying to carry on.
>
> It was frequently necessary to haul carloads of coal on branch line passenger trains to take care of communities that were out of fuel. Important main line trains, as well as those on branch lines, were frequently stopped not only at intermediate points but at public crossings between stations to pick up stranded motorists and others. Even the Empire Builder and other fast trains stopped to pick up hospital patients and doctors.
>
> While trains were frequently late, nevertheless the railroads carried on at their own expense, and in a general way successfully. They did not sit back like a helpless child and wait until the expenditure of public funds made public highways available for private gain. When the sun shines again and the highways have been cleared, let us not forget the railroads and their thousands of men who helped us in this emergency.

Functioned Perfectly

The Great Neck (Long Island) News referred, in its issue of January 24, to railway service during one of those characteristically heavy snow storms for which this area is noted:

> The Long Island railroad functioned perfectly during the latest brief but potent blizzard. As nearly as could be determined, every train came into Great Neck on time, and that meant a lot of intelligent work. The high wind and heavy snow made a dangerous combination. But no one wrote to the newspapers about it or even talked about it. There was plenty of conversation about the prodigious difficulties of individuals in reaching the station, however, with never a thought that the railroad's problems were even greater.

Particularly significant to industrial areas was the comment in the Pittsburgh (Pa.) Sun Telegraph of February 10:

> Were it not for the fact that railroads have been able to supplant ice-clogged rivers, Pittsburgh would be crippled industrially. The railroads have been moving 300 cars of coal a day to plants of the Carnegie-Illinois Steel Company and 150 cars a day to plants of the Jones and Laughlin Steel Corporation. Both organizations usually get their coal by river. Two and sometimes three locomotives to a train have been needed to get the coal through, but the railroads have handled the unexpected job.

Of particular interest has been the reaction in the

agricultural areas. The Daily Drovers Journal, Chicago, is a leading spokesman for livestock raisers, and its comment on February 4 is, therefore, informative:

Railroads are the most dependable and economical method of transportation for livestock. This has never been demonstrated so convincingly as in the last two weeks of severe weather.

In Rural Areas

In similar vein, the Dawson County Review, Glendive, Mont., commented on the dependence of that area on the railways:

Our dependence upon the railways has been forcibly brought to our attention the past winter. The heavy snows, severe cold and winds of January and February brought home to all who think that after all the railroads are the backbone of our transportation system and are very likely to remain such for some time to come.

Snow blocked all of the secondary highways in the northern and central states for months and the highway forces were hard put to it to keep even the main through roads open. But in spite of the terrific weather conditions, the railroads managed to operate. Trains were frequently late and it was an onerous and expensive job to keep them moving, but move they did and service was maintained. Innumerable towns would have been isolated for weeks and incomprehensible suffering would have resulted if the railroads had all been torn up and dependence placed entirely on our highways.

From the Greenville, S. C., News came the following:

It is during such severe weather as has prevailed continuously since the first of the year that the traveling public appreciates the railroad service at its command. The storms which have held the country in an icy grip for weeks, except for short respites, have brought perils to motorists and seriously hampered air travel. But the railroads have been able to meet the extraordinary demands made upon them with startling efficiency. In times of weather crises our railroads stand out as the nation's supreme transportation service. They are an asset that is unappreciated and one that should be guarded with more consideration than they have been wont to receive in recent years at the hands of the public and its agencies.

And from the Times of Watertown, N. Y.:

Were it not for the fact that the railroad has maintained its service all through this severe winter, there have been times when transportation would have been paralyzed all through this section. People who like to criticize the railroads should learn a lesson from the experience which we have had this winter. The railroads have demonstrated their supremacy in the transportation field. They have shown the absolute necessity for their existence. They are entitled to every consideration, not only from the people whom they serve, but also from municipal, state and national governments.

How About the Trucks?

Turning for a moment to the railways' competitors, the Bangor (Me.) Commercial refers to the trucks in the following statement:

There have been frequent dispatches in the newspapers during the recent frigid weeks of coal shortages in many mid-western states. The fault is in our "modern" transportation system. Truck transportation has supplanted railroad transportation to such an extent that when the weather gets really bad, movement of fuel and other necessities is virtually at a standstill. There is something lacking in a "modernized" transportation system that proves, in an emergency, to be inferior to the "outmoded" means of moving freight that proved magnificently adequate in the past.

In a somewhat similar vein, the Bend Bulletin, of Bend, Ore., referred to the effect of truck operation on the highways. It is significant that the editor of this paper was formerly chairman of the highway commission of that state:

Travelers over the oil macadam surfaced highways of eastern Oregon in recent days have found them in a condition that is worse than that existing at any time since they were built. The surface is broken down, there are chuck holes with loose stones lying about and in some places the whole bottom of the road has gone while windrows of mud and rock have been thrown up along deep ruts, making passage difficult and sometimes, for a while, impossible.

There can be no doubt but that the winter of unusual length and severity has had much to do with making these conditions possible. Frost has gone deeply into the ground and now it is coming out with the usual results. The winter and the frost, however, are but minor incidents in the story of highway destruction. Heavy trucking is the thing that has broken up the surface and cut the deep ruts in the roadbed weakened by frost.

We have no idea of what it will cost to put these broken highways back into shape but we venture the guess that the state would be money ahead if it had paid for moving by rail all the freight that has been carried by the trucks that have done this damage. What now occurs is the payment of the cost by the general highway fund contributed to by all motorists. That is one of the things that helps to make trucks unpopular.

Railroads Not Done Yet

And Boake Carter, news commentator, added the following in a radio broadcast on February 7:

Speaking for the eastern seaboard at any rate—a coating of snow, lying on top of a coating of ice, makes for a thoroughly unpleasant and dangerous combination. And planes have been grounded again—trucks and automobiles are stalled—and bus schedules have gone all haywire. But then every dog has his day—and it seems the railroads are still pounding right on through, their schedules virtually intact. The railroads are not done yet as a method of transportation for freight and passengers, irrespective of all the claims made by their competitive transport colleagues in the bus, truck, automobile and freight divisions. And if the railroad men of the nation have been enjoying a broad grin these last few weeks of impossible weather—they are entitled to their grin. They've demonstrated that their transport show goes on—no matter what happens.

Recognition such as this, from so many sources, should be highly pleasing to every railway employee. More than this, however, it should demonstrate to every employee the importance of using every opportunity to tell the story of railway accomplishment during the critical days of the last winter, in order that the indispensability of the railways may be universally appreciated. And by no means the least important contact is with the newspapers in one's own community.

Rail Orders

Sharp Upturn in Maintenance Work Indicated

ORDERS for rail purchased by 35 of a group of 50 representative roads since October 1, 1935, totaled 711,845 gross tons, or more than twice the amount of rail that all of these 50 roads ordered for their 1935 renewals. Furthermore, this 711,845 tons is 78,266 tons more than the volume of rail purchases made by 38 roads in the corresponding period of 1933-34 when buying was artificially stimulated by federal PWA loans. The orders of these 35 roads in a period of seven months is actually larger than the total rail production in the United States in the entire 12 months of 1935, as reported on page 293 of this issue. Thus, the railways are taking active steps to overcome the deficiency in renewals that has accumulated during the last five years.

This increase in rail buying has occurred simultaneous-

ly with a stepping up of the maintenance of way expenditures, which has taken place at an accelerated rate during the winter months, as shown in the table below.

	1933	1934 Thousands	1935
November	$26,071	$27,873	$31,398
December	23,040	25,334	29,938
January	25,164	27,684	30,423
February	25,164	25,552	32,415

Thus, the expenditure in November, 1935, was 13 per cent larger than in 1934 and 20 per cent greater than in 1933; in December the increases were 18 per cent and 30 per cent; in January they were 8.5 per cent and 20 per cent, and in February they were 27 per cent and 29 per cent. It is evident from these figures that the railways have taken prompt advantage of the increase in earnings to begin to make good the deficiencies in the maintenance of their properties that have accumulated during the last five years. The marked increase in rail orders constitutes an indication of the optimism with which they are viewing the months immediately ahead.

Progress

How Far Have We Come in 25 Years?

EVERYONE who has had anything to do with the maintenance of tracks and structures in recent years is aware of the marked changes that have taken place in materials, methods, equipment and organization. But it is a question whether there are many who have a real conception of the aggregate effect of these changes during the last generation. In other words, how far have we come in 25 years?

It is especially appropriate that such a comparison be made at this time, because it is just 25 years since the appearance of the first issue of the Maintenance of Way Section of the Railway Age Gazette, immediate predecessor of *Railway Engineering and Maintenance,* and the first publication to record from month to month current developments in maintenance of way and structures. Moreover, an examination of the May, 1911, and following issues of the Maintenance of Way Section, affords an exceptional picture of the practices, policies and points of view 25 years ago, and discloses some sharp contrasts with corresponding conditions today.

It is especially noteworthy that the leading article in the first issue, comprising a report on the status of the track motor car, indicates clearly that this device was then looked upon as a distinct innovation. This article was based on data obtained from 41 railroads embracing 89,618 miles of lines, and of these 41 roads, 9 had no cars at all and 9 others owned an average of only 5 or less. Twenty-one roads were using 560 section cars, or an average of one to every 106 miles of line while 26 roads had 889 inspection cars, or one to each 66 miles of road. The most extensive users of section cars were the Chicago, Milwaukee & St. Paul and the Union Pacific, the former having 199 cars, or one to every 38 miles, and the latter having 144 cars, or one to every 24 miles, at that time.

But the status of the motor car at that time is brought out even more emphatically by the tone of the article—that of presenting the pros and cons concerning a development with which many of the readers had no direct knowledge. From the fact that the article devoted considerable space to data on the cost of operation and the estimated savings, it is evident that the author felt the need for demonstrating the economy of these new agencies of transportation. He knew that his readers were not entirely "sold" to the idea. Moreover, he also directed attention to the opposition of many foremen to this innovation and to the concern expressed by several officers regarding the loss of time resulting from breakdowns or inability to get the cars started.

Space in this and other early issues was given to other appliances for reducing the cost of work, but it is significant that far more attention was devoted to home-made "kinks" developed by ingenious foremen or supervisors than to manufactured appliances. The reason for this is obvious; very few of the mechanical appliances used by the maintenance forces today were in existence 25 years ago. The tie tamper was unknown, relatively few locomotive cranes were in use, and the only rail crane mentioned in any of the articles was a home-made device involving the use of a long lever mounted on a dolly that was moved transversely across the top of a push car.

Another noteworthy characteristic brought out in these early issues is the fact that much of the development work represented the efforts of individual division or supervisory officers. While such measures no doubt received the encouragement of the higher officers, there was evidently far less of a tendency toward experimental work on a system basis.

Considerable space was devoted to means of recruiting capable men and to the characteristics of different types of foreign and native labor, but gang organization was evidently deemed the exclusive province of the foreman. There was a singular absence of articles outlining the equipment, organization and procedure employed in handling such operations as laying rail, ballasting or tie renewals, based on careful studies.

Turning to track materials, we find that no little space was given to demonstration of the economic justification of rail anchors, in which attention is directed to their superiority in holding track as compared with the then-prevailing practice of slot-spiking the joints. There was a dearth of references to manganese trackwork, but this is explained by the chaotic state of that field prior to the organization of the Manganese Track Society in 1913. It must be recalled, also, that less than one-fourth of the ties inserted in 1911 were treated, that the renewals averaged around 300 per mile, and that 75 per cent of the rails rolled in 1911 weighed less than 100 lb. per yard, compared with only 22 per cent in 1935.

Thus, we see that maintenance of way operations, as they are conducted today, differ widely, not only as to methods, equipment and organization but also as to the nature of the property being maintained, from those that prevailed in 1911. This difference has come about as the result of progressive changes that have been recorded from month to month in *Railway Engineering and Maintenance*. By giving publicity to the progress being made, by interpreting the trends as they have been brought to light, and by urging further progress this publication has endeavored to promote improvement in maintenance methods through the years.

Patrols Replace on the

The New York, New Haven & Hartford has largely replaced its trackwalkers with motor car and foot patrols who devote practically their entire time to inspection. During the two years in which this system of track inspection has been in effect on the New Haven it has proved highly satisfactory and has resulted in substantial economies.

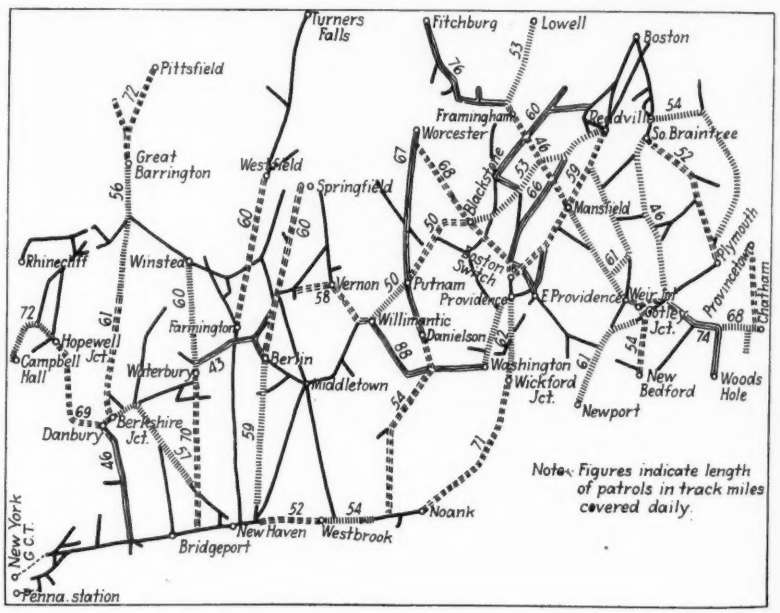
AFTER two full years' experience with motor and track patrol systems of track inspection, which have largely superseded section trackwalkers on the road, the New York, New Haven and Hartford is convinced that it is not only obtaining a higher standard of track inspection than was secured with section trackwalkers, but also that the patrol systems have other advantages and, at the same time, effect a substantial saving.

Early in 1933 the New Haven had 313 trackwalkers assigned from various section gangs to track inspection work, whereas today it has only 64 such trackwalkers, the work of the remaining men having been taken over by 40 motor patrols and 12 track patrols, and the men returned to their regular track gangs. The motor patrols are essentially experienced trackmen who patrol specific territories on motor cars, while the track patrols are experienced men who walk the track, much like section trackwalkers, but who devote their entire time to inspection and cover considerably larger territories. Under both the motor and track patrol systems of inspection the section foreman is relieved of jurisdiction and control, and all of the patrolmen report, and are directly responsible to, the track supervisors.

Improved Track

The New Haven does not believe in the elimination of regular track inspection. However, in view of the improvement that has taken place in the track structure, which automatically eliminated much of the work that was commonly looked after by the section trackwalkers, and the large annual expense of keeping 313 men on track inspection work constantly, the road began to investigate the feasibility of establishing strictly track patrols, and especially the patrolling by motor car of tracks where traffic was not too dense and where territories of suitable length could be set up.

There was little question about the adequacy of the trackwalker system of inspection from a safety standpoint, but it appeared that many phases of the duties of the trackwalkers under this system had been reduced to a minimum in recent years through the adoption of heavier rails, deeper ballast, improved joint bars, heat-treated bolts and coil spring washers. Furthermore, in many cases, the time spent by the trackwalkers on other than strictly inspection work had been reduced from as much as 50 per cent to as little as 15 per cent, and the time so saved was not always employed effectively on other work. As a matter of fact, this was impossible in many cases and the trackwalkers filled out their time as best they could, sometimes with the track gangs and sometimes around their tool houses. At the same time, the actual replacement of some section gangs by extra gangs, with largely expanded territories, made it impractical to continue section track-



Diagrammatic Sketch of the New Haven, Showing in Heavy Lines and Figures the Limits of the Various Track Patrols

Trackwalkers

New Haven

Above—One of the Track Patrols on the Four-Track Territory Between New York and New Haven. Left—Equipped with a Light Inspection Motor Car, the One-Man Patrols Inspect Many Times the Amount of Track Formerly Covered by Trackwalkers

walkers on these territories on the same basis as practiced formerly.

The New Haven has approximately 85 miles of four-track line between New York City and New Haven, Conn., and entering Boston; a small mileage of three- and six-track line in these same territories, and approximately 700 miles of double-track line, while the remainder of its mileage, approximately 1,400 miles, consists of branch lines scattered principally throughout Connecticut, Rhode Island and up into Massachusetts, which carry relatively infrequent train service, some only freight. In considering motor patrols, thought was given only to double- and single-track territory, no motor cars having been permitted for a number of years on the high-speed, frequent-service, four-track territory.

Following careful study of the mileage and local conditions in all of the single- and double-track territory, patrol sections were laid out where it was found that suitable mileage requiring inspection could be grouped into continuous territories. The practice of motor patrols was then started in a small way to permit its possibilities to be carefully analyzed; in 1933 it was greatly expanded, and at the present time it is in effect in 40 territories. On single-track lines, the territories are as long as 44 miles, requiring a patrol movement of 88 miles a day, while the longest patrol in double-track territory is approximately 35.5 miles in length, involving patrol movement over 71 miles of track a day. Most of the patrol territories include mileages considerably below the maximums mentioned, as will be noted in the accompanying chart showing the extent of the various patrols, the average length of line patrolled being approximately 30 miles.

The length of the various patrol territories was determined not alone by mileage, but also took into consideration traffic conditions and the amount of special work necessary. Unlike the section trackwalker, the patrols are relieved of all routine maintenance work, their primary duty being to inspect the tracks, roadbed and right-of-way to insure that they are in a safe condition for train operation. Only in cases of emergency are they required to do any track repair work; otherwise they report directly to their track supervisor any work needed to be done, or, if immediate attention is required, to the nearest track foreman and then to the track supervisor. In other words, the patrolmen are not repairmen, but rather trained inspectors whose first duty is to inspect their territories thoroughly and then leave all but emergency repairs to the regular track forces.

The Inspection Work

However, the inspection work of the patrols comprises more than merely riding over the track since they are required daily to inspect all switches, switch stands, switch locks, guard rails and frogs, and to clean and refill all switch lamps. Furthermore, they are required daily to test-oper-

ate all automatic grade crossing warning devices, and once a week, to oil, test-throw and check the adjustment of all switches.

To carry out their work, each patrol is equipped with a light-weight, four-wheel inspection car, suitably fitted with tool and material trays. Two men were first assigned to each patrol, one of the men acting as a helper, but when the patrolman had become fully acquainted with his routine operations, the helper was released for other duty, until at the present time only eight of the patrols have regular helpers. In these eight cases the helper has been retained because of the large amount of auxiliary work to be done, or because of some other special condition. For example, two men form the patrol on the double-track freight line from Hopewell Junction, N.Y., across the Hudson river at Poughkeepsie, to Campbell Hall, a territory that requires movement over 72 miles of track daily and has approximately 135 switch lamps which must be given attention. Three other two-man patrols of 61, 56 and 72 miles, respectively, are employed on the single-track line between Berkshire Junction, Conn., and Pittsfield, Mass., where in addition to a large number of switch lights to be refilled daily, there are special track problems which require more than ordinary attention.

Tools Carried

To carry out their prescribed duties and to be prepared for emergency work, the patrols carry a shovel, a spike maul, a tamping pick, a track wrench, a kit of tools for adjusting switches, a few bolts and spikes, and a supply of oil for refilling switch lamps, in addition, of course, to flags, torpedoes and fusees for warning and protection.

Each patrol has a permanent headquarters to which it returns at night. In single-track territory, two trips are made over the same piece of track, in opposite directions, on each daily inspection. On the first trip, special attention is given to the track structure, while on the return the track is looked over again, the switch lights are attended to and consideration is given to general right-of-way conditions.

In double-track territory, one trip is made over each track, slowly enough to permit close observation of the track as well as the general condition of the entire railway property. Ordinarily, the motor patrols move at a speed of approximately 8 to 10 miles per hour.

The patrols operate on all days on which scheduled trains are run, which means seven days a week in most territories, but as few as four to six days a week on certain minor branch lines. All of the patrols move only under operating messages obtained from the dispatcher. Before starting out in the morning each patrol gets in touch with the dispatcher, either direct, or through an operator if available, and obtains his message which allows him to operate over the main track. Subsequently, throughout the day, he must renew his message as it expires, and as he progresses from one point to another.

In addition to this checking in with the operating department, the patrols are required to contact their respective supervisor's office three times a day, in person or by phone; before starting out in the morning, at about noon, and again at the close of the day's inspection. At the morning check-in, each patrolman ascertains which gangs will be working on his territory and their location, so that in case of emergency he will know where to obtain the quickest possible assistance in an emergency.

Maintain Contact

Checking in at noon permits advising the patrols of any important changes in gang locations, keeps the supervisor's office advised of the progress of the patrol work, and also permits passing on special instructions or information. In the evening the patrols merely check with the office to assure the supervisor that the daily inspection has been completed, and to advise of any special conditions that may have been encountered. This evening check-in is accompanied or followed each night by a brief written report, which states the hours worked and calls attention to any conditions found which require prompt attention. No special form is used, and no detailed statement is required of the specific items of work accomplished by the patrol.

The obtaining of the operating message and the triple check-in with the supervisor's office may appear to consume a considerable amount of time but, in reality, they take only a very few minutes since on practically all of the lines covered by the motor patrols, there are from eight to ten telephones available directly in the path of normal movement. On the other hand, the requirements that the patrols operate only on message minimizes much of the hazard of the work and frequently avoids lost time on the part of the patrols in waiting for trains unnecessarily. Likewise, the close contact required with the supervisor's office obviously has many practical and potential advantages.

One of the Few Two-Man Motor Track Patrols on the New Haven

Track Patrols

The 12 track patrols employed on the four-track territory between New York City and New Haven, and also on the multiple-track territory in the vicinity of Boston, where motor-car operation is prohibited, operate on much the same basis as the motorized patrols, except that the men inspect the track on foot. Each patrol carries a track wrench, a spike maul and a red flag.

Like the motor patrols, the track patrols are required to check in with the supervisor's office three times a day, but here again this offers practically no delay to the men as company telephones are located along the right-of-way at intervals of approximately one-half mile throughout the territory.

The trackwalkers formerly employed on the New York district covered an average of 2.6 miles of four-track territory a day, in both directions, walking a total of 5.2 miles, whereas the present track patrols, relieved of routine repair work and concentrating eight hours a day on inspection, cover an average of 6 miles of four-track territory a day in both directions, walking approximately 12 miles. In the four-track territory the patrols concentrate their attention on two tracks each day, while giving a

light or general inspection to the other two tracks. Alternate tracks are always covered each day, primarily so that the patrolmen can always face traffic, but also because this gives him a better chance to see conditions over the entire right-of-way in his round trip.

Where an important interlocking plant or terminal is located on a patrol territory, the patrol headquarters is so fixed that inspection can be given this point early each day. This is primarily because of the heavy early morning commuter business handled both on the New York district and in the vicinity of Boston, and the desire to check conditions at these important points to insure that everything is in good condition before this traffic begins to move. The initial terminal or interlocking inspected is always given a second careful inspection at the end of the day, and any other interlocking plants on the territory are inspected carefully on both the morning and the return trips. As with the motor patrols the track patrols make only brief written reports each night, covering the actual time worked and any unusual conditions observed that require special attention.

Storm Inspection

In addition to the normal day-time inspection of the patrols, both the motor and track patrols are required to go on duty at any hour of the night when heavy storms occur which might jeopardize the safety of the track. Both types of patrols have instructions to start out without waiting to be called, and to make careful inspection, giving special attention to areas or points which are most likely to be affected by the storm. The only exception to this rule arises on those branches where it is known that there will be no train movements until the following day, in which case the inspection may await daylight.

Emergency night or storm inspections by the motor patrols are carried out under operating messages, the same as the regular daily inspections, and only under the most severe conditions do the one-man patrols take a helper or an assistant with them. However, a one-man patrol may call for assistance from the regular track forces if, in his judgment, conditions warrant.

The relatively few section trackwalkers still employed on the New Haven are confined largely to yard and terminal areas, or to territories which could not be worked effectively into the track or motor patrols. On a few stretches of branch line, the foreman in charge of the track makes the only inspection that is made, this being as infrequent as once or twice a week, or only on those days on which trains are operated, except in cases of possible emergency.

Through its system of track and motor patrols the New Haven is convinced that it is getting a higher standard of inspection than under the old system of section trackwalkers, and at the same time it is effecting considerable economy. In the first place, the men in the patrols devote their entire time to inspection work and are held strictly responsible for the safe condition of the tracks in their territories. Furthermore, all of the patrols are picked men of long track experience, many of them having been foremen or assistant foremen who were relieved of their titles in the abolition of the section system of maintenance. These men, now on patrol work, still have a position which ranks considerably above those in the track gangs, and they receive a rate of pay that is approximately midway between that of trackmen and foremen.

Some little concern was felt at first as to the effectiveness of inspections made from motor cars, but this has disappeared as the motor patrols have functioned effectively and have daily found conditions that it might be expected could only be observed by a man on foot. One of the best indications of the effectiveness and completeness of the motor patrol inspections is the record of rail defects found, which shows that approximately 80 per cent of all classes of rail defects reported are found by the patrols.

Are Informed Daily

Another advantage seen in the patrol system is in the direct report made to the track supervisors, who are thus promptly, daily at least, informed of conditions over their entire territories. Being so informed, the supervisor is in a better position to organize and direct the work of his foremen and gangs and also to schedule his own movements most effectively. In addition to the practical advantages found in the track and motor patrol systems over trackwalkers, the cost under these systems has been cut approximately in half, taking into consideration all factors having bearing on the cost, including the operation and repair of, and investment in the motor cars that are used by the motor patrols.

Inspecting for Bolt-Hole Breaks*

By C. H. R. Howe,
Cost Engineer, Chesapeake & Ohio, Richmond, Va.

SINCE the assemblage of the parts comprising a rail joint of modern design is such that only the head of the rail is exposed, any inspection of the rail end that is made without removing the joint bars will be superficial, to say the least. Casual inspections of this character are being made constantly, not only by the welders, but also by the section foreman and track walkers. In fact, the majority of fractures through bolt holes are discovered in this way.

Hard to Find

Contrary to what might be expected, the better the standard of maintenance the more difficult it is to detect incipient fractures, even when the joint bars are removed. The practice of dipping the new bars and bolts in oil when laying rail and of periodically reapplying a similar coating, tends to form a film which fills and obscures cracks and rust streaks. Furthermore, systematic and uniform tightening of the bolts retards the extension of the cracks to a certain extent. In this connection, it is doubtless true that transverse fractures within the limits of the angle bars are far less serious than fractures at other points in the rail length. It is also noted that in the operation of the Sperry detector car the electric indications are cut out automatically while passing over the length of the joint bars.

In attempting to arrive at a conclusion with respect to the necessity for removing the joint bars and making a thorough inspection of the area surrounding the bolt holes, many factors must be given consideration. Among these are the weight and strength of the rail, the type of joint bars, the size and quality of the

*This discussion was submitted for publication in the "What's the Answer" department in the October issue, but because of its scope it was withheld for presentation here as an independent article. For further discussion of this subject, see page 609 of the October, 1935, issue.

bolts, the number of bolt holes, the number of supporting ties and their condition, the character of the ballast and the general line and surface of the track. The hazard of fractures through bolt holes may vary in degree. In a six-hole joint, fractures through holes No. 1 and 6 are probably the most dangerous, since the rail is held less securely by the joint fastenings at these points. The same comment also applies to the end holes, No. 1 and 4, of a four-hole joint bar.

Some Breaks More Serious

Cracks through the inside holes should cause little trouble unless the fracture is compounded and extends along the web, immediately under the head, thus permitting the head to break out. If cracks through the holes next to the joint gap extend into the head, they may be detected when welding by the glowing, if the heat extends back far enough.

Any attempt to evaluate the possibilities of serious results from fractures through the bolt holes is, obviously, out of the question, but a rough idea of the probability of such fractures in a given case may be obtained readily. As an illustration, in 1934, a certain railway had a line mileage of 3,117 and an annual traffic of 12,595,000 gross tons. The main-track mileage was 4,120, giving an average traffic density of 9,295,000 gross tons per mile per year. During the year in question, 488 failed rails, not including those detected by the Sperry car prior to actual failure, were removed from the track, of which 42 were removed because of the presence of bolt-hole fractures.

This rate was 1 joint to 100 track miles, or 0.01 such failure per mile of track. In relation to traffic, this became one joint failure for 929,500,000 gross tons carried. It is evident, therefore, that the probability of failure for any given joint is apparently negligible. It should be noted also that none of those 42 failures caused any serious results.

There are certain economic features connected with the removal of the joint bars that should not be overlooked. Simply removing and replacing the bars for the purpose of inspecting the rail for fractures will cost from $50 to $125 a mile, depending on the type of joint and whether power or hand wrenches are used. This statement is based on the assumption that the welding is to be done out of face.

On the other hand, when the welding program is being prepared, it should be determined whether the wear on the under side of the rail head and the condition of the bars is such as to warrant a replacement with reformed bars, which will further prolong the life of the rail in addition to the increase in life to be effected by the welding itself. If we assume that the cost of installing the reformed bars will be from $616 to $672 a mile, that the cost of a track mile of 130-lb. rail with fittings is $15,000 (disregarding salvage), and that the average life of the rail is nine years, the annual rail cost is then $1,667. If by applying the reformed bars, the rail life can be increased to 10 years, the saving will be $1,667, which is considerably greater than the cost ($672) of renewing the joint bars. In making the renewal, ample opportunity would be afforded to make an inspection of the rail web and bolt holes at no extra cost.

Rail Production in 1935 Was 711,537 Tons

RAIL production in the United States in 1935 totaled 711,537 gross tons, a reduction of 27.2 per cent compared with the output of 1,010,224 tons in 1934, according to statistics prepared by the American Iron & Steel Institute. The tonnage rolled in 1935 was, however, considerably greater than for either 1932 or 1933, when the corresponding totals were 402,566 tons and 416,296 tons, respectively.

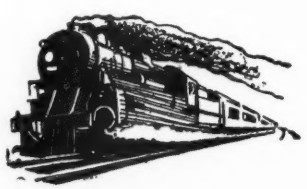
A comparison of the production of rails in 1934 and 1935 according to the various weight groups shows that there were reductions in all groups except "85 lb. and less than 100 lb." and "136 lb. and over," the most outstanding change being a decrease from 325,942 tons to 154,367 tons in rails weighing 120 lb. and less than 136 lb. The only pronounced increase was in the heaviest group—from 31,805 tons to 58,858 tons.

Of the total of 711,537 tons rolled in 1935, 691,665 tons were open-hearth steel, 565 tons were Bessemer and electric steel and 19,307 tons of rails were rolled from old rails. The open-hearth rails comprised 97.21 per cent of the total, or exactly the same proportion as in 1934. A total of 25,940 tons embraced girder or high-tee rails and 520 tons of alloy steel rails. The figure for alloy steels is the smallest for any year except 1933 (437 tons) and compares with 12,909 tons in the year 1920.

Production of Rails by Weight Per Yard

Years	Under 50 lb.	50 and less than 85 lb.	85 and less than 100 lb.	100 and less than 120 lb.	120 and less than 136 lb.	136 lb. and over	Total
1920	489,043	433,333	952,622		729,118		2,604,116
1921	211,568	214,936	902,748		849,566		2,178,818
1922	265,541	274,731	728,604		902,900		2,171,776
1923	272,794	300,907	864,965		1,465,850		2,904,516
1924	191,046	213,274	853,431		1,175,581		2,433,332
1925	163,607	219,648	765,371		1,636,631		2,785,257
1926	197,260	256,287	797,662		1,966,440		3,217,649
1927	161,836	173,257	539,445	1,314,424	617,524		2,806,486
1928	134,197	125,726	465,393	1,203,749	718,428		2,647,493
1929	141,362	102,944	409,628	1,233,599	834,605		2,722,138
1930	95,626	81,299	267,879	835,496	592,933		1,873,233
1931	50,089	25,524	123,398	495,752	462,988		1,157,751
1932	16,655	13,705	28,593	215,091	128,522		402,566
1933	*49,116	†15,413	40,973	154,007	156,787		416,296
1934	*70,085	†17,111	73,639	491,642	325,942	31,805	1,010,224
1935	*57,127	†14,758	85,627	340,800	154,367	58,858	711,537

*60 lb. or less per yard. †Over 60 and less than 85 lb. per yard.



RAILROAD PURCHASES—The railroads of the United States expended a total of approximately $612,500,000 for fuel and materials and supplies during 1935. While the total purchases of the railroads in that year were approximately $12,000,000 under the corresponding purchases of 1934, it is important to note that purchases in the latter year were financed to a considerable extent with government loans, while purchases in 1935 were paid for almost entirely out of railway funds.

Underpins Old Masonry Pier Under Severe Difficulties

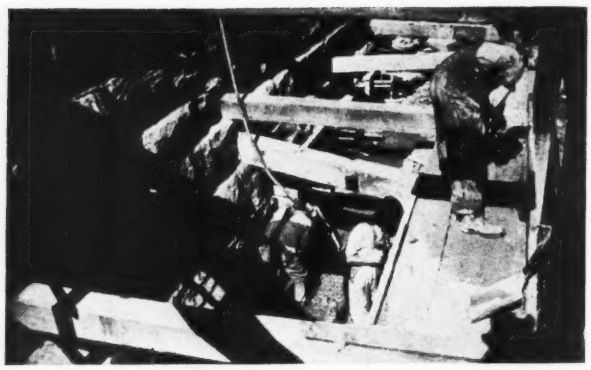
The Pier in the Grand River Bridge as Enclosed by a Steel Sheet Pile Cofferdam During the Repair Work

This article describes how forces on the Central region of the Canadian National successfully repaired the foundation and encased the base of a large old stone masonry structure, which inspection by a diver disclosed had been undermined seriously by the scouring action of the current, in spite of heavy riprap protection. Confronted with fast water, rapidly changing stages of water level, severe ice conditions, and the weakened condition of the pier itself, many difficulties surrounded the work, which required the observance of special precautionary measures.

UNDER the handicaps of traffic, fast water, severe ice conditions and the weakened condition of the structure itself, which at times caused delay and called for skillful engineering to avert disaster, the Central region of the Canadian National recently underpinned and encased the base of a large stone masonry pier which had been undermined seriously by scouring action. This work, involving a structure 67 ft. high, with a base area of approximately 660 sq. ft., was done in connection with the extensive program of underwater masonry inspection and repair which the region has been carrying on during the last three years. Employed on this project, which has embraced more than 200 structures, have been expert divers and masonry repair gangs, especially skilled in the technique of underpinning and in the building and unwatering of cofferdams.

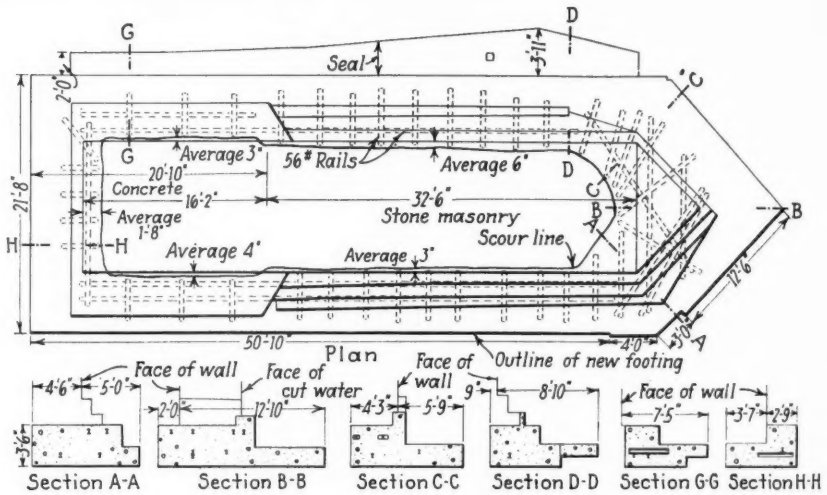
The specific work described in this article was done on Pier No. 3 of the Grand River bridge, near Paris, Ontario, a double-track structure of five spans, 767 ft. long and approximately 100 ft. high at the track level. Pier No. 3, which was built in 1856, was a stone masonry structure 67 ft. 1 in. high and about 55 ft. long by 12 ft. wide at the base, including a concrete masonry addition about 17½ ft. long, the latter having been added to the downstream end in 1902. Careful underwater inspection showed the characteristic faulty construction of many early structures. In the first place, it was essentially a shell of heavy cut stone, with a core of loose river stone and gravel. Furthermore, it had been seated directly on the sand and gravel of the river bottom, in spite of the fact that stable rock was only a few feet below. The only protection that had been given to the base was riprap, which, presumably, had been added to from time to time.

While the superstructure of the pier gave no indication of a weakened condition, a preliminary inspection of the portion below water, not covered by riprap, showed a number of open joints and some settlement of a few of the stones in the



Above—Within the Unwatered Cofferdam at the Base of the Pier, While the Underpinning Work Was Under Way

At Right—Plan and Sections of Underpinning, Showing Arrangement of Rail Reinforcing



end approximately one-half mile above the bridge, broke with the pressure of the water. Suddenly, a wall of tumbling water and ice cakes, about 10 ft. high, appeared rushing at us. The workmen climbed to safety just as the torrent struck the nose of the cofferdam with terrific force. The water level rose six feet in five minutes. Ice piled up at the cofferdam nose to a height of 10 ft., or level with the top of the sheeting. Fortunately, the cofferdam held, without moving an inch. The water level began to lower in about 20 min., and in two hours the river was normal, with the exception that, whereas it was formerly frozen across, it was now clear of ice, except about the nose of the cofferdam where it remained piled to a height of 8 to 10 ft."

nose. Furthermore, there was evidence of considerable wash and scour about the base, and of movement of some of the riprap.

Removed Riprap

To determine the exact condition of the foundation, it was decided to clear away all of the riprap and make a detailed inspection. Shortly after dredging was started, a diver found several loose stones in the nose and then several entirely out of place. Completion of the dredging disclosed that there were 13 stones out of place in the nose near the base, and that the sand and gravel footing beneath the nose had been scoured away to a depth of 2 to 4½ ft., and 5½ ft. inward. One stone was also out of the base shoulder on the northeast side, and another out of the base shoulder on the northwest side, and both the side and down-stream shoulders were undermined inward a distance of 3 to 3½ ft.

With firm shale rock less than 3 ft. below the bed of the river, the pier had been set directly upon a bed of coarse gravel, which varied from 3 in. to 15 in. in depth. The riprap placed about the footing had afforded the gravel bed some protection, but fast water, working its way through the riprap, had washed out most of the smaller material from beneath the outside stones.

Finding this condition, a slow order was placed on train operation over the bridge and plans were rushed to underpin the scoured portions of the foundation and to repair the underwater portion generally. In carrying out this work, the first operations involved the complete removal of the riprap and then the surrounding of the pier with a sheet pile cofferdam. Both of these operations presented difficulties, which were added to by the fact that the work was carried out during the winter months when the hazards of ice floes and a general ice break-up were always present. As a matter of fact, work was suspended and all equipment was removed on several occasions when a general ice movement threatened, and on one occasion, with one of the general break-ups, the ice piled about the cofferdam to a height of 10 ft.

On this particular occasion, the foreman reported that, "the ice jam, which had formed during the week-

Ice Hazard

The seriousness of the ice situation was increased by a dam about 300 ft. below the bridge, which often caused floating ice to back up to a considerable depth about the bridge piers, where it remained for days. Furthermore, the dam permitted rapid rises of the water level in the river following storms of any magnitude.

The removal of the riprap and gravel about the base of the pier, which was done with a bucket-equipped locomotive crane operated on the bridge, had to be carried out with the greatest care, and presented difficulties, especially along the sides of the pier when the bucket ropes had to be let down through the ties of the bridge deck. Furthermore, the dredging had a tendency to damage the pier footing further by removing such support as was given

by the surrounding riprap and gravel, and the greatest care had to be exercised not to allow the bucket to catch in the cavities where stones had been displaced, for fear of loosening or pulling out additional stones, many of which were held in place merely by the mortar that was present in the joints.

Constructing Cofferdams

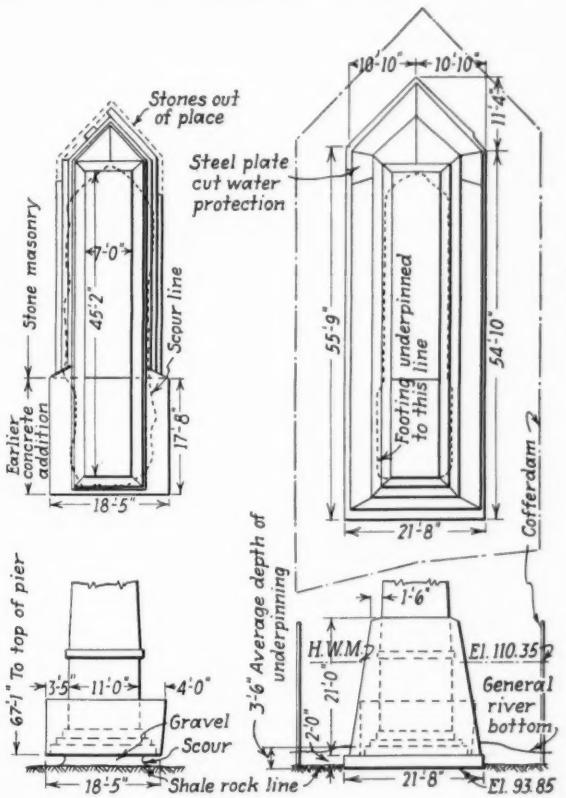
Simultaneous with the preliminary dredging, carpenters laid out the framing for the cofferdam and then, working from timber rafts, began to assemble the frame about the pier. This latter work was done under difficulties, occasioned by the current of 6 to 12 miles an hour in the river, and required that the rafts and all timbers be lashed constantly to the pier or tied to the bridge to avoid being carried away.

The frame initially consisted essentially of heavy timbers at the water level, securely drifted together, with an A-shaped cut-water upstream to reduce the pressure of the current. This top framework, which was to form the top support for the steel sheet piling enclosure, was securely braced against all faces of the pier, special care being given to this work because of the hazard of high water and impounded ice.

When the top frame was in position, placing of the sheet piling was commenced, individual piles being lowered into position by the crane. After dredging to rock and seating the piling, it was planned originally to seal the cofferdam at the base by tremieing concrete along the foot of the piling. However, inspection by the diver as the piles were being placed, disclosed that, in spite of the excavation that had been done, the piling was standing on a layer of boulders and gravel that had been washed back into place. In view of this, excavation was continued along the inner side of the sheeting and the method of sealing the bottom was changed to one of seating the piling on half-filled bags of concrete.

In carrying out this work, six or seven piles were drawn up at a time, for a distance of about two feet, and were propped in this position by timbers. Then the diver, working with an air jet of 100 lb. pressure, supplementing a second jet operated by a man from above the water level, cleared out all of the loose material down to solid rock. As soon as this was done, the half-filled bags of concrete were lowered to the diver, who placed them directly beneath the line of piling.

In this operation, irregularities in the rock were filled with the bags, and the bags themselves were overlapped slightly to insure a continuous seal. This having been done, the diver was brought up, the props were withdrawn from the piles, and the piles were lowered on to the bags. To insure a tight seal, the piles were tapped down by means of a jet-type steam hammer suspended from the crane boom, to embed them in the bags, care being taken not to cut the bags and release the filling.

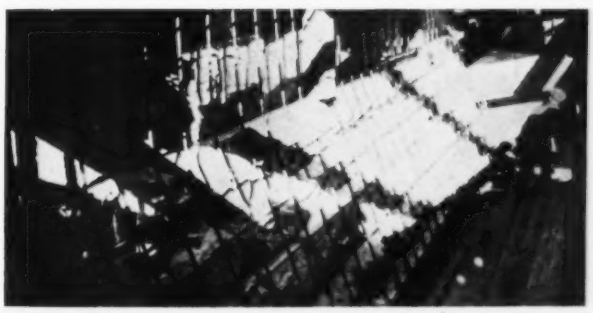


Plans and Downstream End Elevations Showing the Undermined Condition of the Pier and Pier After it was Underpinned and Encased

Diver Inspected Piles

As soon as the hammer operation was completed on each group of piles, the diver was sent down again to see that the piles were seated properly. While making this inspection, he blew out the sand and gravel from beneath the next group of seven or eight piles and placed the bags of concrete for their final seat. While this work was going on, carpenters bolted about every seventh seated pile to the top and next lower walings, and provided additional horizontal strut and A-frame braces against the body of the pier. Following this procedure, the entire base of the cofferdam was sealed and the top was fully braced for unwatering.

This work, which under favorable conditions could have been done quite rapidly, took 28 days. This was because of frequent long interruptions in clearing the bridge of equipment for train movements, and the conditions in the river. On certain days the current was too fast to permit safe diving operations. At

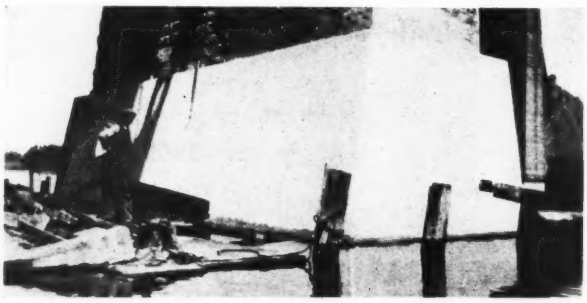


Rod Reinforcing in Place, Ready for Placing Concrete

other times, when there were signs of a break-up and of the ice going out, work was suspended, and at still other times, mush ice flowing beneath the top ice greatly retarded the movements of the diver and slowed up operations.

Sealing Completed

On March 1, the work of sealing the cofferdam was completed and walings had been bolted around the outer side of the piling, as well as around the inside, to afford additional strength and stiffness to the cofferdam to withstand the stresses of sudden high water and ice jams. Working platforms had also been built within the cofferdam, and two 12-in. gasoline engine-operated centrifugal pumps had been installed for unwatering.



The Completed Envelope about the Base of the Pier

In the first unwatering operations, the water level in the cofferdam was lowered only sufficient to permit the installation and bracing of lower walings, allowing the water to seep back during the night. After the fourth level of walings had been put in, however, it was decided to keep the cofferdam unwatered continuously until the completion of the underpinning work.

Used Cinders

Fine cinders were used in sealing the interlocked joints of the piling. Top leaks were sealed by merely dumping the cinders along the outside of the joints, but deeper leaks were sealed by lowering the cinders in bags and spilling them near the leaks. To be effective, this had to be done while both pumps were working to full capacity. After the cofferdam had been sealed and fully unwatered, one pump was capable of handling the seepage, although the second was kept ready for use in emergency. Any sizable leaks which developed were repacked immediately with cinders.

With the cofferdam unwatered, the underpinning of the nose, which was in particularly bad condition, was rushed. However, the condition existing here required that the work be done with the greatest care to avoid loosening or dislodging additional stones. The program followed in this work was to excavate all loose material from beneath the washed areas down to rock, then to underpin the stone masonry with reinforced concrete, and finally to encase the entire pier, to a height of about 21 ft., with a reinforced concrete envelope.

All of the steel reinforcing used in the underpinning was old 56-lb. track rails, spliced together with fish plates where long lengths were necessary. These reinforcing rails were laid both parallel with and at right angles to the faces of the pier, usually in two layers, as shown in the accompanying sketch. All of the rails projecting inward beneath the footing were extended out beyond the faces to afford a tie between the underpinning and the concrete of the envelope.

Concrete Envelope

The concrete envelope was made to extend from 4 ft. 6 in. to 4 ft. 10 in. out from the different faces at the base, and was provided with a batter of approximately 1 to 6, to a thickness of 1 ft. 6 in. at the top. The reinforcing provided in the envelope consists of a network of both 56-lb. track rails and ¾-in. round reinforcing bars, placed both horizontally and vertically, the arrangement varying somewhat in different sections with the condition of the pier. As a rule, an increased amount of reinforcing was provided in the upstream half of the envelope.

At the sections given the heaviest reinforcing, rails, on approximately 3-ft. centers, were placed vertically near both the inner and outer faces of the envelope, the rails in each face being tied together by short rails, placed horizontally. Through certain sections, rails were used only back of the battered outside face, bars being used near the inner face, while in other sections, bars alone were used near both the outer and inner faces. In addition to the reinforcing, the entire nose of the envelope, to its full height, was protected by ½-in. steel plates.

Another Problem

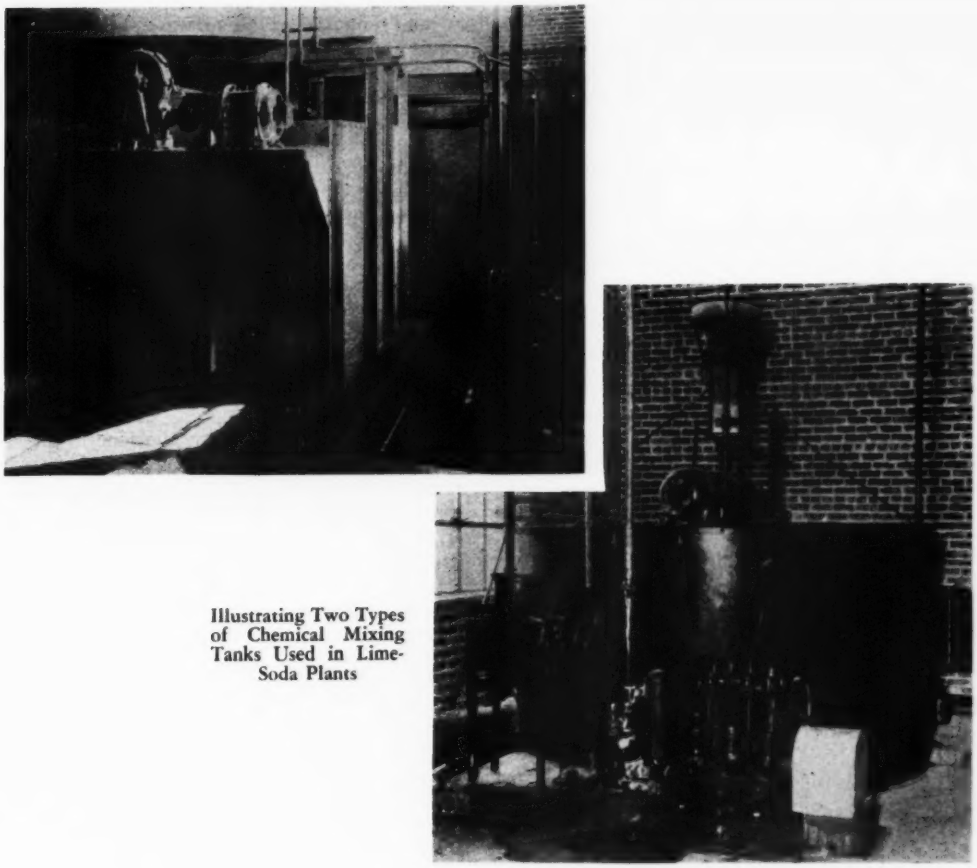
The placing of the reinforcing and the construction of the concrete underpinning and envelope forms presented a considerable problem in view of the large amount of cofferdam bracing that had to be maintained in place. This problem was solved by carrying out the underpinning work in sections around the pier, and by carrying the envelope up continuously in tiers, frequently adjusting the bracing to new bearings.

All of the concrete used was mixed on platforms along the embankment at one end of the bridge and was delivered in dump buckets to the locomotive crane on the bridge, which lowered it to the working levels below. The concrete used in the underpinning was dumped on platforms within the cofferdam, near the base of the pier, and was then shoveled into place, while practically all of that used in the envelope was deposited over chutes, sometimes from a hopper of 2 cu. yd. capacity constructed at an elevation of 30 ft. above the bed of the river.

Placing the Concrete

The concrete in the envelope was deposited in one continuous pour. As the level of the concrete rose in the forms, the cofferdam braces against the pier proper were cut out and replaced against the outer sides of the forms. Thus, the envelope was constructed with a solid face, without brace holes, and without at any time weakening the support given to the cofferdam. The top of the envelope was sloped for drainage and was provided with a chamfered edge.

The work involved in underpinning and encasing the pier was planned and carried out under the direction of T. T. Irving, chief engineer of the Central region, and C. P. Disney, bridge engineer, and was done under the immediate supervision of T. H. Harrington, bridge and building foreman, to whom we are indebted for the details contained in this article.



Illustrating Two Types of Chemical Mixing Tanks Used in Lime-Soda Plants

The Lime-Soda Process

A Review of Methods and Equipment

This is an abstract of a report prepared by a sub-committee of the Committee on Water Service, Fire Protection and Sanitation of the American Railway Engineering Association, which was presented at the recent convention. It reviews the development of the lime-soda process and describes the various types of equipment now in use.

THE oldest method of softening locomotive boiler water is by treatment with lime and soda ash before the water goes to the boiler. In its earliest and simplest form, as used by Dr. Clark of Aberdeen, Scotland, in 1840, the equipment consisted of two tanks which were alternately filled with raw or hard water, dosed with the proper amount of fresh lime, well agitated and allowed to settle to remove the bicarbonates. Later the treatment was improved by William Porter in England to include the use of soda ash to eliminate the non-carbonate hardness. In the course of time this method of softening and cleaning water, known as the Clark-Porter process, became known as the lime-soda treatment.

About 1880, with the aim of cheapening the installation and speeding up the process, one small tank was used for the continuous mixing of chemicals with a stream of raw water, and one large tank for settling the precipitate from the continuous stream. From this date the first method described has been known as the "intermittent process" and the other as the "continuous process." Both are satisfactory and give good results. The term "continuous" implies the addition of the softening chemicals to the water as it is pumped so that it flows, in turn, through reaction and sedimentation chambers, the softened and clarified water being delivered from the latter to a storage tank or direct to service lines.

While each of these methods is referred to as the "lime-soda process" because of the common use of these reagents, the equipment is complete

for the use of any reagents or any variation of methods which the character of the water may demand. If the water carries colloidal matter, or for any other reason settlement is difficult or the chemical reaction is slow, a coagulant can be added in combination with lime and soda ash or by separate feed.

According to available records, the first continuous plant for softening water on an American railroad was installed in 1900 on the Denver & Rio Grande Western at Helper, Utah. At the present time plants of this type in railroad service vary in capacities from 12,000 to 150,000 gal. per hour, and have settling tanks ranging in diameter from 12 ft. to 62 ft. and in heights to meet service requirements.

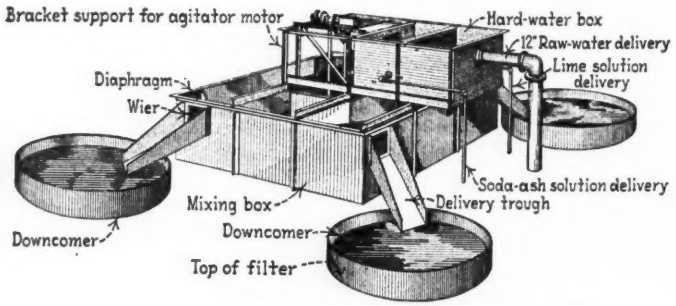
Early Equipment

In the earlier types of continuous plants the chemicals were pumped from a vat at a constant rate by means of a small steam pump, being discharged at the top of the treating tank into a chamber where they were mixed with the raw water, the treated water being drawn off by means of troughs or floating outlet pipes. This type of equipment did not permit the chemical control to be varied in accordance with the necessity of maintaining a constant ratio between the chemicals and raw water delivery, and often resulted in over or under-treatment.

The next step in chemical control was the development of what is known as the top-operated plant in which all of the chemical equipment is installed on top of the treating or settling tank. This apparatus consisted of a round or square chemical mixing vat with an agitator, which was driven from a water wheel operated by the flow of raw water or by an electric motor. Chemicals were delivered to the raw water by gravity through a floating outlet pipe suspended in the chemical vat, which was lowered by means of a cable connected to a float and counterweight in a proportioning tank. This tank was filled with water delivered through a weir or orifice arrangement located in a box into which the raw water was discharged prior to entering the downtake tube.

This type of plant necessitated the elevating of chemicals to the top of the softener, which was objectionable because of the difficulties imposed in keeping a check on the operation and in making repairs. Most later developments have centered around ground-operated chemical vats and proportioners. In these developments the weir and orifice are retained on top of the tank and the flow piped to a proportioner tank on the ground, the chemical mixture flowing from the chemical vat into a sump from which it is pumped to the top of the settling tank and mixed with the raw water.

In another type of plant developed for ground operation the chemicals were mixed in a square or rectangular vat and were pumped continuously into a container located at the top of the softener above the downtake tube, the raw water being discharged into a tipping bucket which operated a valve in the bottom of the chemical container, allowing a gravity flow of chemicals for each dumping of raw water. The ratio was then regulated by varying the concentration of the chemical solution used or the chemical container valve setting.



Showing the Layout at the Top of a Large Lime-Soda Plant

Proportioning Equipment

The chemical proportioning equipment employed in modern treating plants embraces such devices as simple displacement water motors (or engines) of various sizes connected to chemical pumps, orifices, weirs, tipping meters, venturi tubes, and meter controls for constant and variable feeds. Such controls have been found to provide sufficiently accurate proportioning for dependable results if given the required attention.

The water motor, a reciprocating type, is operated by the flow of raw water through it and in turn drives a pump delivering a proportionate amount of chemical solution. This type of equipment maintains a chemical ratio with fluctuating water delivery and is particularly adaptable to locations where electric power is not available. The economical operating range of this equipment is 100 to 600 g.p.m. The weir, orifice and tipping meter type of chemical control operates by by-passing a proportionate amount of the raw water delivery to a chemical float chamber or tipping meter, which in turn lowers an outlet pipe in the chemical vat, allowing a flow of chemical solution in direct proportion to the raw water pumping rate. This type is adaptable to plants of any capacity.

The Venturi Tube

Where the proportioning equipment is based on the use of the venturi tube, the raw water passes through a venturi tube located in the discharge line, the differential pressure being used to operate a control valve which in turn regulates water delivery to a uniform rate. In such installations the chemical solution is pumped at a constant rate, dependence being placed on the tube to control the pump delivery of raw water. The venturi tube is also adapted for use with a variable rate chemical feed, in which application the control valve is eliminated and the differential pressure is utilized to regulate the flow of chemical solution to the pump suction. This type of control is used in plants of large capacity and with installations in which the raw water delivery is at a fairly uniform rate.

In still another type of control, a meter is installed in the raw water discharge line, which may be fitted with a drum with a cable control extending to a swinging pipe in the chemical vat, or with an electrical attachment which controls the lowering of the chemical outlet pipe by means of an electro-magnet ratchet appliance. In installations of this type the amount of chemical solution delivered to pump suction bears a uniform relationship to the flow of raw water through the meter. Controls of this type are adaptable to plants of all capacities and in particular to those where the delivery of raw water fluctuates, as is often the case with city or river supplies in which the pumps work under varying heads.

The chemical mixing vats in use in modern treating plants are of two

distinct designs involving (a) vertical agitation in either round or square vats, and (b) horizontal agitation in square or rectangular vats with cylindrical bottoms. Either type is adaptable to dependable service and selection should be based on the space available and the capacity required for proper treatment of the water supply. The agitating apparatus may be driven by water or an electric motor. Satisfactory speeds of vertical agitators range from 8 to 12 r.p.m. (peripheral speed 120 to 190 ft. per minute) and of horizontal agitators from 5 to 8 r.p.m. (peripheral speed 115 ft. per minute).

In selecting a chemical vat, consideration should be given to the requirements for treating the raw water supply, using one of sufficient capacity to run the plant for 12 to 24 hr. with a chemical solution not exceeding 0.5 lb. of lime per gallon of water in the vat. Chemical solutions of greater density may be used in special cases but they require more power for agitation.

There are many types of pumps manufactured which are adapted for pumping chemical solutions. Those most universally used are simplex, duplex and triplex single-acting power-driven plunger pumps and centrifugal motor-driven pumps with open-type impellers. The size and capacity of such equipment depend on the requirements of the plant. The power pumps are usually driven by chain drive from an extension of the shaft on the chemical vat.

In order to maintain uniform treatment it is essential that the chemical equipment be started at the same time that the raw water supply enters the reaction chamber, and be stopped when the supply is cut off. This is accomplished with an automatic electric control which is operated by increased pressure in the discharge line or by direct connection to the controls of the raw water pumps. There are many dependable types of equipment available which are adaptable to this class of service.

In the treatment and clarification of certain raw waters containing colloidal matter, it is not possible to produce clear softened water by mixing the coagulant with the lime and soda ash. In order, therefore, to secure complete clarification, auxiliary equipment may be installed, comprising a small coagulant vat from which a solution of alum, copperas, sodium aluminate, or other reagent can be pumped at a constant rate. A small electric motor-driven pump may be used for this purpose, discharging coagulant directly into the raw water line. Other types of coagulant-feeding apparatus are available for handling dry reagents, which are used successfully in numerous installations.

In many plants where the high hardness and character of water justify, sludge recirculating pumps are used to draw the sludge from the bottom of the sedimentation tank, discharging it directly into the raw water line or into the mixing chamber at the top of the downtake tube. The obect of this recirculation is to provide small particles of solid matter that aid in the formation of floc and thus facilitate clarification. In addition it affords opportunity for further utilization of unexhausted chemicals that may be discharged in the sludge. Centrifugal pumps with open-type impellers are adaptable for this service.

Conclusions

(1) The mechanical device for introducing reagents must be such as to insure a quantity of reagent as nearly as possible in direct proportion to the flow of untreated water.

(2) The type of equipment for such installations can best be determined by a careful study of all local conditions, giving consideration to the various annual operation and maintenance charges.

Surfacing Track Out-of-Face*

By Robert Herald

Section Foreman, Cleveland, Cincinnati, Chicago & St. Louis, Fairland, Ind.

SURFACING track out-of-face costs our railroad more money each year than any other one kind of work. With this fact in mind, we must so plan our work on the track that is to be raised as to do this work the best and cheapest way. This is not difficult for a foreman who takes pride in doing good work as economically as possible.

When I have a section of track to raise out-of-face, I first go over my track, before any lifting is done, with a spot board and sight over blocks at intervals of about every 10 rails, setting the board at whatever height the reading over the blocks indicates, and then mark the height of the lift on the rail at the spot board location. I continue this procedure for a half mile or more. In starting this work, I set the board the first time by sighting off track that has already been lifted. To get the height at the next setting of the board, I put under my sighting and lifting blocks the amount of the lift indicated by the board and then continue until I have covered the track to be raised. This plan works very nicely except on vertical curves where it is necessary to set the board either much closer to or higher than the lifting.

Going over one's track in this manner gives him the amount of lift, which allows him to check with the amount of ballast he has to do his lifting with. If the lift is running too high for the amount of ballast at hand, one can lower the lifting stations and still carry a good surface. Where ballast is plentiful, a large part of the track can be lifted to the readings of board settings and an excellent job can be obtained. One should never lift track more than is permitted by the amount of ballast available to tamp and dress it with. He should always use a spot board for out-of-face lifting, being sure to sight the same distance from the jacks each time. Also he should never allow the back tampers to come closer to the jacks than one rail length. Track should be raised to the exact line on the board each time; the foreman should then go ahead of the jacks and look back to detect any low spots. This affords an opportunity to pick up these spots while looking at the well surfaced rail behind. It also will provide a perfect rail surface ahead of the end tampers.

A foreman should never permit low spots to be tamped with the expectation of taking them out later, for this requires tamping again and such track cannot be surfaced as well. Since most surfacing work is done in the warmest months of the year, I try to raise track in the early part of the day, finishing and tamping only the ends of the ties; I then tamp the centers and line the track later in the day. I do this to lessen the probability of the track buckling during the heat of the day. *(Continued on page 305)*

*Abstracted from a discussion of this subject at the thirteenth annual convention of the Association of Maintenance of Way Foremen, Cleveland, Cincinnati, Chicago & St. Louis, at Toledo, Ohio.

The Speeding Up of Heavy Trains Is Increasing the Problems of the Maintenance of Way Forces. This View Shows the Twentieth Century Limited on the Hudson Division of the New York Central

Prolonging the Life

By C. B. BRONSON

Inspecting Engineer, New York Central System
New York

In a searching analysis of the factors governing the life of rail Mr. Bronson lists five principal causes of rail deterioration, but ascribes greatest importance to conditions at the joints. Bad joints, he believes, can be best corrected by removing defects in the joint bars and then by overcoming the battered condition of the rails by welding or otherwise.

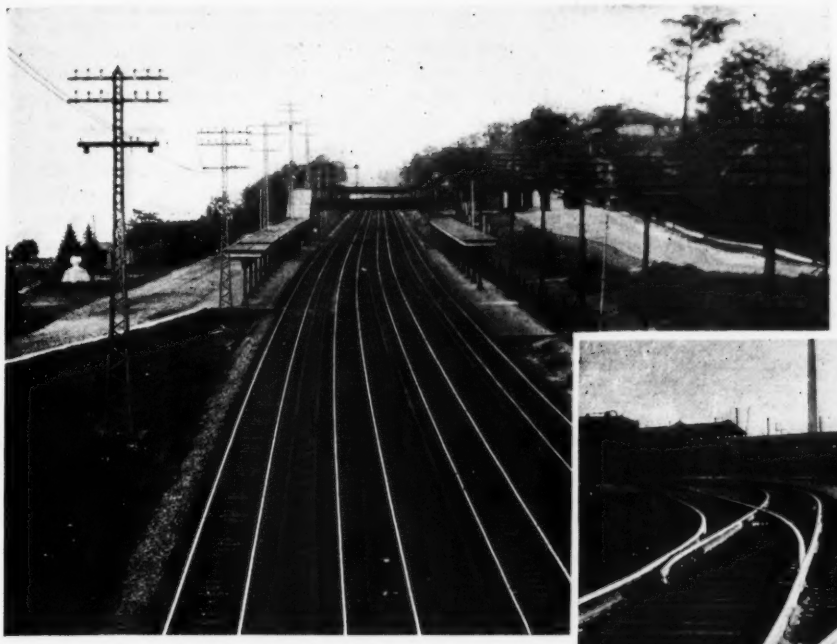
AS THE result of the reduced maintenance of way budgets of recent years, the purchase of new rail has been restricted and the life of existing rail has been extended. It has been surprising to all of us to see how well our rails are standing up. Apparently we did not have a full realization of the capacity of rails to take punishment.

From an operating standpoint, two factors have had an important bearing on rail life. One of these is the tendency to speed up both passenger and freight traffic which, obviously, is causing greater abuse of the rails and the track generally; the other and brighter side of the picture is the trend toward lighter and better designs of power and equipment. This latter development represents the greatest progressive step in the last quarter of a century, although it will take years before the older and heavier units are retired. The speeding up of service, however, can, and is being done immediately with present units, thus increasing the problems of the maintenance of way forces and creating the necessity for a uniformly high standard of track.

The problem with rails is to determine, first, how we can prolong their life to obtain the maximum usefulness from them under existing conditions, and second, what can be done to improve the quality of rails rolled in the future. Many of us have long relied on the brand or date on the rail to determine when it should be renewed. There was a somewhat prevalent belief that after a certain number of years service, rail steel crystallized, or became brittle, and was then no longer safe for main-line, high-speed service. This idea has been definitely disproved.

Scientific tests and studies have shown that sound rail steel is capable of withstanding millions of stress reversals below a certain fairly well defined limit and can furnish continued long life under such conditions. Occasional overloading, however, is one

*Abstract of a paper presented before the International Railway Maintenance Club, at Hamilton, Ont.



Sound Steel Is Capable of Withstanding Millions of Stress Reversals, Provided They Do Not Exceed Certain Fairly Well Defined Limits

fe of Rails*

thing to guard against. Another is the inability of a small percentage of physically unsound rails to stand up in service.

What are the principal causes necessitating rail renewals? The first reason is rail failures. This, however, is responsible for a very small percentage of the total. Care and vigilance by the track forces are required to weed out those rails with failures which can be detected visibly, such as crushed and split heads, breaks through fissures, base breaks, web cracks and bolt hole breaks. Supplementing this, the Sperry detector car is aiding tremendously in picking out premature or impending failures, notably internal fissures, thus adding to safety of travel and indirectly aiding in prolonging the life of rail.

A second reason for rail renewals, and by far the principal reason in the past, is the condition of the joints. We will refer to this later.

A third reason is head wear. On tangent track this is a minor problem for extensive experience has shown that few stretches of rail in tangent track have been actually worn out. The statement has often been made that "the ball of the rail is worn out," or "the head is too thin," but more accurate methods of measuring head wear show a surprisingly small loss in depth under heavy traffic. For example, our average loss in depth of head of rail in principal tracks is about $\frac{1}{16}$ in. in 10 years.

Flange Lubricators

Rail renewals due to curve wear can be reduced decidedly by flange lubricators of various types. We have many instances of greatly increased life of the high rails on sharp or fairly heavy curves; in fact, the low rails flatten out and wear down long before those on the high side must be renewed because of curve wear. Wear of rail then, cannot be considered a major factor in general rail renewals on either tangent or curved track.

A fourth cause for rail renewal is damage caused by equipment, such as kinked rails, the result of excessive counter-balance effect; rails nicked or broken by wheels with a portion of the rim missing; rails burned by spinning or skidding wheels; and corrugated or so-called "singing rails." With long trains and high-speed braking, burned rails are becoming more numerous but, in general, the number of rails which require renewal because they are burned excessively is quite small.

The same is true with regard to corrugated rail. Many roads have a considerable mileage of such rails, although they are by no means out-of-face, and vary in intensity from rail to rail and even in the same rail length. The average depth of these

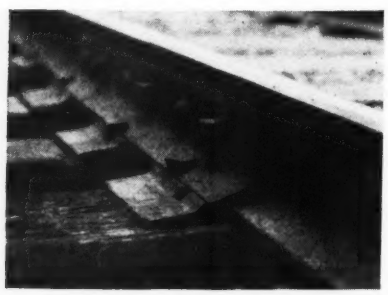
corrugations is about 0.005 in. This may seem unbelievable to many in view of the roar they cause as a train passes over them. The specific cause of corrugations is highly debatable, but seems to be associated principally with wheel slip, similar to the action of an automobile wheel on a gravel road. In any event, again, we cannot consider this class of defect a real or general reason for rail renewal.

Corrosion

A fifth cause for rail renewals, which is local to roads carrying considerable refrigerator equipment, is corrosion due to brine drip on the rail and fixtures. This exacts a terrific toll on the steel. The problem is serious with us on our principal eastbound tracks and constitutes by far the major reason for such rail renewals as we are now making. We are waging a grim and determined battle against this enemy.

The longer the rail remains in service, the more serious the problem becomes, because the corrosion goes on at an accelerating rate. The real excessive corrosion is confined to the receiving ends of the outer splice bars, where the brine is swept in by the suction of trains and attacks the rail flange and web as well as the splice bar. A somewhat similar, although less severe, action takes place around rail anchors.

We are determined to solve this problem. In the first place, at least once a year we spray the entire length of the rail with a heavy oil of asphaltum base, applied hot from jets on a special oiling car. When new rails and bars are assembled, a liberal application of heavy oil or grease around the joints is desirable and necessary.



The Corrosion of Rail Is Usually Most Severe Near the Joints

We are also experimenting with various types of grease packing to more-or-less seal up and prevent brine getting in behind the receiving ends of the outer bars.

On the older rail, the task of protection against brine corrosion is magnified. The bars must be removed; all rust must be chipped and brushed from the rail web and base, and from the bars, and then oiling and greasing must be done as mentioned previously. Another place where corrosion occurs is on the bottom of the rail base in contact with the tie plates. All around, therefore, it is evident that we have a real problem on our hands, particularly in our eastbound tracks which carry the major part of our refrigerator loads.

On certain rather limited territories, we have had another type of corrosion to contend with; that is, the galvanic action created when live coal and stoker ash accumulate back of the joint bars. Mechanical department officers are readily aware of this condition and steps are being taken to remedy it. It is felt that the cleaning of fouled ballast and the use of some type of blower to dislodge the refuse packed around and behind the bars are effective ways of correcting this situation.

Joint Problem

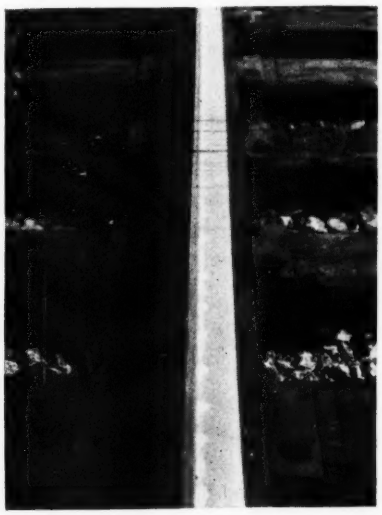
While the corrosion problem is vital and serious on certain tracks and territories, and chiefly, if not solely, responsible for rail renewals in many cases, and while failures, head wear and damaged rails of all types enter into the picture as causes for a certain amount of renewals, it is believed that conditions at the rail ends or joints have been the governing factor for years in most decisions to renew rails.

With effective ways and means to repair or improve the joint conditions of old rail, a tremendous tonnage of rail can be preserved for many years, with large economies. We know definitely that joints in poor condition can be restored to an efficient basis. We know also that good riding track can be obtained only for a very short time if the joints are not in good shape.

Fix up the joints and great improvement in riding occurs. Two primary methods for accomplishing this are available, namely; correcting the looseness or play in the fishing areas, and correcting battered rail surface conditions by welding or otherwise.

It appears in most cases that the cart is placed ahead of the horse, or that the horse is entirely overlooked, for it seems to be the tendency to resort to rail end welding first and to overlook the primary difficulty—looseness through the bars. A case is recalled on a certain road where rail end welding was considered necessary to correct a battered condition of 1/128 in., and was argued pro and con. At the same time, the looseness in the bar fit was a proverbial mile.

A good slogan to follow is—fix up your joints first, and let welding be the measure of last resort. Metallurgically, more harm than good is being done by welding, no matter how well conducted. In the face of the variables to contend with, including the personal element, one cannot cast metal in the field by any method and obtain the uniformity, either structurally or physically, of the rolled steel in the original rail head. It is realized, however, that tremendous value and benefit and large savings have accrued from building up battered rail ends that have gone too far to be saved otherwise. The point which is emphasized is, that one should start with the basic trouble of joint bar looseness and build a firm foundation before undertaking anything else.



Rail Corrugation Has Become Quite a Problem on a Number of Roads

Shims Vital

There are several ways of correcting the loose or hinge action through joints:—by applying new, oversize bars, which is the least effective way; by reforming old bars with a pressed crown in the head to compensate for the worn rail fishing area; or by removing and reversing the present bars and applying head shims to the center. In my judgment, the last mentioned method is a very effective and economical way of accomplishing the most good. Recent changes in the design of shims and in the method of their application have made them decidedly sound in principle and effective in service. We have more than 50,000 pairs of these shims scattered over our system, under the hardest kind of service.

After correcting the joint condition, and not before, is the time to

size up what you believe is batter. Invariably, removing looseness from the joint will reduce what appears to be batter. Even then, however, a straight-edge may show 1/32 in. or more drop at the rail ends, only a part of which represents true batter. We are finding on our lines and on other roads that this measurement is affected by surface irregularities, principally bumps over the bolt holes adjacent to the rail ends, which accentuate what may be considered as batter. With this in mind, we have found that by a small amount of surface grinding, using machines built specially for the purpose, we can smooth up the running surface across the joint gap so that 1/64 in. dip in the receiving rail in one-way track, or in either end of rail in single track, is a lot. Such methods may appear new or radical, but to us they are effective as well as far less costly.

Adequate Support

One further important factor in prolonging rail life, which is obvious, is that, regardless of whether we have old or new rail, proper line and surface by means of good ties properly and uniformly tamped, sufficient ballast and adequate drainage, are all of essential importance. Old rail is often given a black eye and placed at a disadvantage, not because the rail itself is in poor condition or in need of renewal but because of neglect of the bed members beneath it. New rail will not correct poor riding on such track by any means. Neglected new rail can and does provide rougher riding than older rail (with the joints repaired) on a sounder roadbed.

Proper Line and Surface, Good Ties Properly Tamped, and Sufficient Ballast Are All Essential

Other factors which bear on rail life are, of course, the section of the rail itself, the type of joint bars and tie plates used, the canting of the rail to secure more uniform wear across the head, and the proper adzing of the ties. I cannot recommend too strongly the pre-adzing of all new ties and machine adzing all ties when renewing rail. The small cost involved will reap enormous benefits.

Having looked at the situation from the standpoint of maintenance, let us now view briefly the other side of the picture,—such steps in manufacture as may add to the service life of rails. While alloy steel rails have been rolled and tried out, and some sizable installations have been made, I believe that our chief reliance for rails is, and will continue to be, in sound, well-made basic open-hearth steel of present standard composition. Important minor improvements are being made constantly in the details of making steel, as well as in the rolling and other various steps of rail manufacture, which are not known to the layman and perhaps not fully appreciated by all maintenance of way men. One of the most important of these improvements, which is now coming into use, is that of controlling the condition of the rail while cooling.

Through joint efforts of the rail manufacturers and the Association of American Railroads, a most thorough investigation has been under way during the last four years, under the direction of Prof. H. F. Moore of the University of Illinois, into the causes and possible remedy for interior transverse fissures. This research and certain other studies have proved that at certain lower ranges of temperature, rail steel is brittle and, under generally exposed conditions of cooling, is liable to rupture internally. Furthermore, there are no known effective means of telling which rails will shatter internally.

Methods have now been devised to reduce the rate of cooling of rails at some of the mills so that shatter can be practically eliminated. The simplest of these is that of removing the rails from the hot bed at temperatures below that where color disappears, and then placing 75 to 125 of them in a covered box for a period of usually 24 hours to retard cooling. Such slow cooling does not soften the rail, while it does away with shattering. Large tonnages can now be handled in this manner. In the judgment of many, this represents the most important development in years. Other methods for eliminating shattering have been developed, but they are to a large extent experimental in character.

As we all know, there is a general movement to harden rail ends, chiefly by various methods in the field. At the same time, the mills are preparing, and in some cases are already offering, to heat treat or harden new rail ends for such roads as desire it. While this hardening of rail ends may be considered desirable by many, we have experienced little benefit from it over untreated ends, probably because of our three-tie type of joint construction with its long splice bar.

Surfacing Track

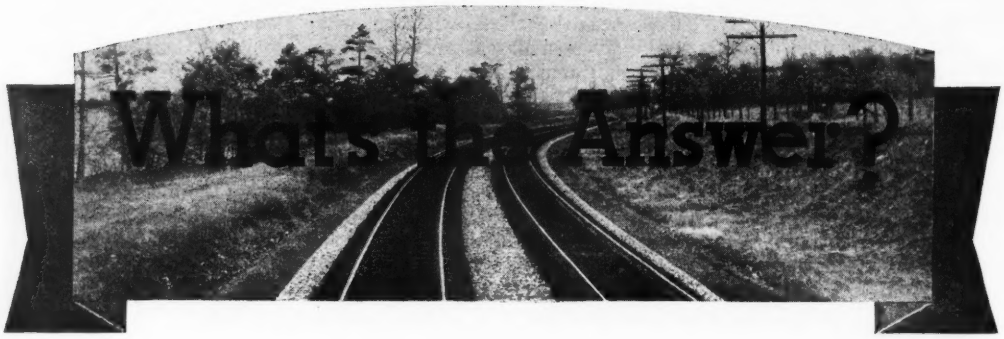
(Continued from page 301)

The distance which ties should be tamped in from the rail depends on the amount of lift given the track. Where track is lifted 2 in. or less, I tamp both sides of each tie about 20 in. in from each rail. Where the lift is higher, I tamp the same distance and then fill in the center of the track. It is my belief that if the center of the track is not filled lightly for high lifts, it will allow the tamping done next to the rail to shift to the void left in the center, weakening the tamping next to the rail.

It has always been our custom to raise joints and centers. However, since we have re-formed angle bars, I get better results by setting the jacks in the short quarters. This seems to pull these re-formed joints down, making the rail look much better.

Lining must be done immediately after the tamping is finished. Track should be lined twice. The first time they go over the track the men should stand back from their bars and line out the swings; the next time they should come closer to the bars to take out the short kinks. Poor lining will soon ruin good surface. The two go together to make perfect riding track and a proud foreman.

Track must be filled in as soon as the lining has been done, and allowed to run until the next day before it is dressed. This will allow the ballast to settle around the ties, and the dressing can be done much cheaper and easier. Each day I always fill and dress the section of track that I raised the day before.



Crowned or Uniform Section?

When laying released rail, is it preferable to use reformed (crowned) joint bars or bars of uniform section? Why?

On One Condition Only

By C. G. Fulnecky

Assistant District Engineer, New York, Chicago & St. Louis, Frankfort, Ind.

Reformed bars for use on released rail are to be preferred only when the fishing surface of the rail head is worn sufficiently to engage the crowned bar for its full length when the bolts are properly tightened. The bar should not bulge out at the center or crown the rail ends, but should fit the same as a new joint with new rail. If it does not do so, there is danger of breaking the rail or the bar, or both.

Again, the ends of the rails will be raised out of surface enough to show, even though they may not ride badly. On the other hand, if the bars have the proper fit, the rail ends will be raised to the proper elevation and they will look and ride like new rail, except, obviously, where end batter has occurred.

If the bars are crowned more than the worn fishing surfaces demand, it may be necessary to loosen the center bolts, thus allowing the bar to spring out and the ends of the rails to drop to the level of the remainder of the running surface. I have known cases where the joint ties were left swinging to overcome this condition. But this is objectionable, since the rail will be surface bent permanently, although for a time it corrects the objectionable appearance of the cocked rail ends.

Crowned bars should never be used with cropped rail, since this would be substantially equivalent to using them on new rail. Even where it is obvious that they will be of real benefit, careful attention should be given to the amount of crowning required to insure elimination of the foregoing objections to their use. They are as useful in replacing worn and bent bars on rail that is to remain in service in the track as on released rail when it is relaid.

Crowned Bars Invariably

By C. B. Bronson

Inspecting Engineer, New York Central, New York

Our experience is that crowned bars should be used invariably with relayer rail, except where the rails have been cropped. In the latter case, bars of uniform section should be used and we prefer them to be slightly oversize, say, 1/64 to 1/32 in. more than the normal fishing height, to compensate for loss of section in the rail from corrosion, as well as to provide for a little more draw into the fishing angles.

Crowned bars are necessary on unsawed relayer rail because there is from two to three times as much wear on the fishing surfaces at or near the joint gap as in the areas near the ends of the bars. Bars of uniform section do not fit tightly against this worn area while the bars will be bowed inward as the bolts are tightened, so that a part of the draw is lost initially. Because of their tighter and more complete fit, crowned bars force the rail ends slightly upward, eliminating many low joints, and thus create smoother-riding track.

For these reasons, it is important that a crown be formed into the bar at the middle of its length, regardless of whether old bars are reformed or new bars are purchased. For our own type of bar and rail sections, this crown should be between 0.02 and 0.03 in. at the center and slope gradually toward the ends of the bar.

One point which probably falls without the limits of the question, but which to me seems to be of equal if not greater importance is that of smoothing up the running surface between adjacent rail ends. There is enough variation between adjacent rail ends to make such smoothing de-

Send your answers to any of the questions to the What's the Answer editor. He will welcome also any questions you wish to have discussed.

To Be Answered in July

1. *When renewing ties, is it good practice to allow a train to pass over the track before a tie is replaced? If not, why?*
2. *What methods can be employed to eliminate slow orders when renewing timber trestles or replacing decks on open-deck steel spans?*
3. *Should anti-creepers be applied opposite joints? Why?*
4. *What means can be employed to protect against termites? Are they fully effective?*
5. *If it becomes necessary to increase the elevation on a curve which has been spiraled, should the length of the spiral be increased also? Why? If not, how should the run-off be adjusted?*
6. *How does one go about cleaning a clogged sewer or sludge line?*
7. *How should one proceed to give first aid in cases of heat prostration?*
8. *What is mildew on paint? How can it be prevented? What can be done to correct it?*

sirable. I am convinced that surface grinding should be done in practically all cases.

A machine-shop leveling job is not necessary but a moderate amount of grinding will create much smoother riding joints and retard subsequent batter. The cost is relatively small—usually less than $0.20 a joint—and the results in improved track conditions far outweigh the cost.

This grinding should not extend farther back than the second bolt hole, except in rare cases, and usually should not reach as far as the second hole. It is also important that the grinding should not be deep enough to remove all of the cold-rolled bearing surface. If the rail ends are trued up to within 1/64 in., this will be a sufficient degree of accuracy for all practical purposes.

Crowned Bars Preferred

By W. L. Roller
Division Engineer, Chesapeake & Ohio, Columbus, Ohio

In laying uncropped released rail, it is preferable to use reformed or oversized bars rather than bars of uniform section to compensate for the wear on the fishing surfaces at the rail ends. This wear, usually most pronounced at the ends of the rail, tapers out within a few inches. This abrasion occurs on both rails and bars as a natural result of the service they perform and constitutes one of the many reasons why rail must be released and replaced with new rail.

If the worn ends are not cropped, some other means must be provided to take up the slack occasioned by the wear on the fishing surfaces. Various devices have been employed to do this. Tapered steel shims are sometimes used. They are made in various sizes and thickness to meet the different conditions of wear. Where bars of uniform section have been used, reformed or oversized bars are sometimes substituted. In other cases, where contact bars have been in service, head-free bars have been substituted. In reforming the bars for use with relayer rail, they are commonly crowned or cambered slightly to compensate for the wear at the rail ends.

Any one of these means can be employed safely to provide continuous contact between the rail and the joint bars and thus insure smooth riding quality to the track, especially since the running surface at the rail ends can be brought to its original contour by welding and grinding. One of the difficulties encountered in applying some of these devices is that of determining with the proper degree of accuracy the average actual wear under the head of the rail, which must be compensated for. Careful measurements must be taken to make this determination, but as all rails do not wear alike it becomes necessary to arrive at an average for the thickness of the shims, the superimposed metal or crown, which will most nearly meet the condition of the rail ends.

One of the simplest and most effective means which I have seen for effecting the desired result was the substitution of head-free bars for those of the contact variety. In this case while the wear on the fishing surface of the rails was pronounced, the area normally supported by the head-free joints had not been worn, thus giving the normal support that would have been given to new rail.

Inspecting Heating Plants

When should a steam or hot water plant be inspected to determine what repairs are necessary? Why? What details should be observed?

As Soon as Shut Down

By L. L. Tallyn
Division Engineer, Delaware, Lackawanna & Western, Hoboken, N. J.

Both steam and hot water heating plants should be inspected immediately after the heating season is over. It is when the plant is inoperative that the greatest damage occurs, owing to the chemical action of soot and ashes. It is a good plan, therefore, to clean the grates and ash pit thoroughly of all ashes as soon as the heating season is over. At the same time, the clean-out doors should be removed and all heating and flue surfaces cleaned thoroughly with a wire brush. In the same way the smoke hood should be removed and cleaned and the chimney inspected and cleaned, if necessary. After cleaning, the grates should be inspected and, if warped, renewed. A warped grate bar will often break the one next to it when it is shaken. All doors should be left open until the plant is again placed in service, to keep the interior surfaces dry.

Insulation should be inspected and repaired. All exposed iron, such as the base, doors and smoke hood, should be painted with black asphaltum. Boilers should be flushed thoroughly and when clean, they should be entirely filled with water, drawing off the excess at the beginning of the next heating season. Likewise, hot water systems should be filled during the inoperative season. On steam plants, care should be given to the water gages, the glasses should be cleaned and repacked; the damper regulator should be adjusted; and the safety valve removed and tested. All radiator valves should be repacked and the air vents cleaned. On hot water systems, the thermometer and the altitude gage should be inspected; all radiator valves should be repacked; and the expansion-tank water gage should be cleaned and repacked. In all plants, the smoke pipe should be taken down, cleaned and inspected.

Make Careful Tests

By John Cole
Water Service Foreman, Canadian National, Toronto, Ont.

In the spring just before the heating plant is shut down, it should be examined for leaks and general repairs. At this time the heating temperature is at its lowest and the lines and boiler are somewhat contracted, for which reason defects are more easily detected.

After repairs have been made, hot water systems should be filled with cold water and, if in good condition, the water should be drawn off. This will tend to wash out scale and sediment which has accumulated over winter. After draining thoroughly, the system should again be filled and allowed to remain until the fire is relighted. Before relighting the fire, this water should be drawn off and fresh water put in. This will prevent rusting of the lines and boiler during the summer, and avoid the detrimental action of rust scales in the pipes, radiators and valves.

Similar procedure should be followed with steam plants, except that the entire system should be blown out with steam, for if any condensation is allowed to remain in the lines or radiators rusting will occur. All traps, drips, etc., should be cleaned and all valves overhauled. Before the plant is placed in service in the fall, the entire plant should be tested with steam at a pressure a few pounds more than is required to heat the buildings. Prior to this, however, the boiler should be given a hydrostatic test of 20 lb., with the safety valve screwed down. If it passes this test, the pressure should be re-

leased to 15 lb. and the safety valve set to blow off at the pressure. The system is then in condition to be placed in operation.

While Still in Operation

By Sidney Stone
Plumber Foreman, Erie, Hornell, N. Y.

Steam and hot water plants should be inspected during the latter part of the heating season, while they are still in operation, preferably about April 1, so that all necessary parts can be purchased and installed during the summer months, in order that they will be ready in the fall. The first thing is to have the steam gage tested to insure that it is registering correctly. Then fire the boiler hard enough to test the safety valve. Next, inspect the grates, the radiator valves and the chimney. After the heating season closes, the boiler in both types of plants should be washed out and refilled with clean water so that all interior surfaces are covered. The reason for this is that if the boiler is filled only partially, the cast iron sections will rust heavily at the water line, but if filled entirely, this will not occur. All traps should be cleaned at this time also. Before the boiler is fired up in the fall, it should again be washed out and refilled to the water line.

Safety in Use of Lining Bars

What precautions should be observed in the use of lining bars to avoid personal injury to trackmen?

These Are Important Don'ts

By L. A. Rape
Extra Foreman, Baltimore & Ohio, Wampum, Pa.

To make the use of lining bars safe, there are so many prohibitions that they can best be set forth in a series of don'ts.

Don't leave lining bars in the lever socket after they have been used as jack handles. If the jack should break or slip, the bar may be thrown violently. For the same reason, don't get your head over the bar while jacking. Don't leave the bar leaning against anything as it may fall and strike some man. While it is permissible, and in hot weather desirable, to stand the bars upright by driving the ends into the soil, don't fail to give them sufficient penetration to insure stability; don't stick them in soil so shallow that they may fall over.

Don't use lining bars for skids without knowing definitely that they will hold the load safely and are secured against slipping. Don't use a bar after frequent or severe bending, such as may occur in a rail bender, without examining it carefully for signs of cracking. Don't put the bars on the motor car in such a way that they might fall off. Don't leave them in such a position, as in nipping ties, that they might be catapulted by a sudden blow. A passing train has been known to throw a bar so left, high in the air. Don't stick a bar through a bolt hole when turning a rail over; for if the rail turns suddenly, the user may be thrown or struck heavily; it is far better to use a rail fork for this work. Don't stick the bar under the rail for lining track until you know that no one has his feet where they might be hit. Finally, don't straddle the bar when using it for any purpose. These don'ts cover substantially all of the hazardous practices in the use of lining bars. If the rules thus expressed are observed, personal injuries will practically be eliminated.

Requires Close Supervision

By W. H. Sparks
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

In the first place, the foreman should know that every lining bar put on the car in the morning is straight, with no cracks or other defects, and that the point is not too blunt, since this will make it difficult to get the bar properly seated in the ballast when lining. A bar that may slip during use may be a dangerous tool. Again, a blunt bar can seldom be used for pinching.

More than one man should never be permitted to use a lining bar simultaneously; injuries are certain to result sooner or later where this rule is violated. Men should be prohibited from straddling a lining bar, particularly when lining track, not a few back injuries having resulted from this practice. When lining track or using the bar in other ways which require a heavy pull, the man should stand with his feet well apart so that he will not be thrown off balance if the bar slips. All of these rules seem simple enough, but as every experienced trackman knows, it requires close and constant supervision to enforce them. Yet a high percentage of the violations result in injuries, although not all of them, are of sufficient magnitude to warrant a report.

Not a Dangerous Tool

By Robert White
Grand Trunk Western, Pontiac, Mich.

Basically, the same precautions should be observed in the use of lining bars as with other tools. They should not be wielded in such manner as to strike a man close to the user or thrown down where someone might stumble over them. While the lining bar is not inherently a dangerous tool, in that it does not have a cutting edge and is not swung around as a maul or sledge is, it can be made decidedly unsafe in the hands of a careless or indifferent trackman. It is my observation that more men are injured through stumbling over lining bars than through actual use of the tool. Three out of every four trackmen will drop the bar where they stand when done with it, instead of placing it out of the way.

Probably the next most fruitful source of injury is the practice of straddling the bar when making a lift; and third is failure to maintain a safe footing to avoid falling in case the bar slips. Leaving the bar in the jack socket or under the end of a tie after nipping may result in severe, and sometimes fatal, injuries, although these cases are somewhat rare. More frequently, men are caught standing in front of the bar when turning rails, frogs, etc., in which event the injury may be equally severe as from these other causes.

Foreman Is Key Man

By Rinaldi Rossi
R. Rossi & Son, Chicago

In large measure "it's up to the foreman." In this, as in all other safety matters in track work, he is the key man who should drill his men in safe practices and then supervise them closely to see that they follow them. Unless he is willing to do this, all other efforts are likely to fail. On the other hand, it is important that proper tools be provided. Lining bars should have wedge points. While the chisel point is only slightly inferior for many applications of this tool, the diamond and pencil types should never be applied to lining bars, since they are suitable only when

handling timbers. The flat wedge or chisel end will not slip in the ballast if properly used, and is particularly adapted for pinching, nipping and unloading rails. Trackmen engaged in lining track or doing other work with lining bars should be compelled to wear safety shoes having thick rubber heels while on duty.

Should Handle Correctly

By Joe Gambino
Section Foreman, Belt Railway of Chicago, Chicago

In lining track, there are two primary precautions to be taken in the interest of safety—the manner of holding the lining bar and the position assumed when making the pull. The proper way to handle the bar before and during insertion under the rail is to place one hand at the end of the bar, slightly overlapping the end, with the other at the point most convenient for the user. If, when swinging the bar backward, it hits a fellow workman, he will not be hurt because the overlapping hand protects the end of the bar and cushions the blow. Otherwise, a serious bruise or broken rib may result. Again, with his hand at the end of the bar, the user can maintain a steadier balance when making a pull, particularly if the bar slips slightly. Men should not be allowed to straddle the bar when making a pull, for if the ballast is loose or the bar slips for any other reason, it may cause a rupture. In any event, it is almost impossible for a man to avoid striking himself if the bar should slip.

When Do Most Accidents Happen?

Is the closing period of a rail-laying or other large maintenance program more productive of accidents than other periods? Why?

Is Not More Productive

By J. E. Long
Superintendent of Safety, Delaware & Hudson, Albany, N. Y.

Our experience has been that the closing period of large maintenance operations is no more productive of personal injuries than any other period of the program. Proper organization of the gang, coupled with adequate supervision, should not permit undue risks being taken at any stage of the work. While our own accident records do not show any increase in injuries during the closing period of large jobs, it is my personal opinion that the opportunity for them to occur is greater at this time for several reasons:

Among them are (a) the number of men engaged in the work is generally being decreased; (b) there is the possibility that supervision will be relaxed, since roadmasters and supervisors will be inclined to devote more attention to other work; (c) the character of the closing work, often practically a clean-up proposition, is such that men are called on to perform a variety of tasks and tend to become careless or take chances in the attempt to finish as soon as possible; and (d) at this time foremen may be engaged in supervising different types of work, often spread over considerable territory, for which reason they cannot remain in as close contact with their men as they were during the main part of the job, at which time they were generally overseeing a single operation.

The prevention of accidents during the closing period of a large maintenance program differs in no wise from other times. Both depend on supervision. On our own road the division officers and those in supervisory capacities recognize the additional hazard of accident toward the end of a job and it is their practice to continue, and possibly increase, supervision at the time the work is being finished. They bring to the attention of the men engaged on the work the necessity for using precautions at this time, particularly when they have gone through the major part of a large job without accidents.

A Change of Viewpoint

By W. H. Sparks
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

Before safety was given the intensive consideration it now receives, the larger maintenance operations, particularly that of laying rail, were often productive of numerous personal injuries. While fatalities or permanent disability sometimes occurred, the bulk of these accidents were looked upon as not being particularly serious, since the patient recovered within a few days, or, at most, a few weeks. They were merely the hazards incident to the work.

Today we have an entirely different conception of the matter. Any personal injury is now serious, since statistics show that with few exceptions they are entirely avoidable. Conditions do not differ basically from what they were formerly. We still strive to do the largest practicable amount of work each day; we hurry at the close of the day's work, as well as at the end of the program; every one is keyed up to a maximum effort at these closing periods and there is always more or less confusion as the different units begin to bunch up; rails must be cut, holes drilled for the connection, compromise joints applied, shims provided and other items cared for during the last few minutes. Yet so well is the safety movement organized today that personal injuries are the exception rather than the rule. The same observation applies to ballasting, tie-renewal, surfacing and other operations on which large gangs are employed.

So insistently has the necessity for following safe practices been kept before supervisory officers, foremen and men in recent years that today no personal injury is viewed lightly. The result is that the closing period of large maintenance operations is unlikely to be any more productive of accidents than any other period.

When the Work Starts

By Thomas H. Carrow
Superintendent of Safety, Pennsylvania, Philadelphia, Pa.

Ordinarily, the period that is most productive of accidents is at the start of the work. This will be especially true if the work has not been planned and is not being properly supervised. The reason for this is that every job has some peculiarities and it requires some time for the men to become accustomed to the routine, as well as for the various stages to become coordinated, that is, properly spaced and synchronized. In many instances, it may be necessary to deviate considerably from established practices and methods. This feature can be overcome largely, however, by job analysis and by careful selection and placing of materials, machinery and men. Much depends on the attitude and ability of the supervision in charge of the job, the nature of the work being performed and the amount of time available to perform the necessary operations.

It has been our experience in laying rail that if the time available is sufficient to permit a fair or good quantity of work to be performed at the usual pace, there is less likelihood

of accidents than if the time is limited, since anxiety to perform as much work as possible naturally leads to rushing the operation. This results in a greater likelihood of accidents, especially at the closing or finishing period when the men performing the various phases of the main operation bunch up and work close together, owing to the progress of the work being retarded by the necessity for cutting rails, etc.

This latter difficulty can be eliminated entirely by arranging for certain men in each unit to step out and engage in some of the finishing work elsewhere while the last few rails are being installed and made safe for the passage of trains.

It is our belief that no part of any maintenance job should be more productive of accidents than others when it is possible to perform the work under normal conditions and in the accustomed way after the men understand their place and the work. In fact, no job is impossible of being made safe at all times. If proper precautions are not taken, however, accidents are more likely to happen during the closing period.

Finally, it should be understood that every job can be surrounded with proper safeguards and, as a matter of fact, what are commonly called the most hazardous operations can be performed in perfect safety.

Not Necessarily

By Everett L. Case

Extra-Gang Timekeeper, New York, Chicago & St. Louis, Buffalo, N. Y.

In considering this question two things should be kept distinctly in mind, namely, the conditions favoring an increase in accidents and what actually occurs under an alert foreman. Certainly, the closing period of any large maintenance program brings many adverse conditions which may contribute to accidents. In almost every instance there is a general attempt to hurry the men in an effort to close the job quickly, particularly if the men are to be moved to some other work. If the gang is not to be moved, the men themselves often become indifferent, since they know that they will soon be laid off. In not a few cases some of them leave voluntarily to go to other jobs. This tends to lower the morale of those who remain and thus leads to general carelessness. All of these factors greatly increase the possibility of accidents, thus necessitating more intensive supervision.

On the other hand, it is not possible to say that as a general rule more accidents occur during the closing period of a large program. I am sure that such a statement would not be confirmed by the records, for despite the adverse conditions which so often attend the closing days of such programs, alert foremen who are well schooled in practical safety are able to close large jobs without injury to their men.

How to Build Scaffolds

Under what conditions and to what extent is scaffolding required in the repair or replacement of timber trestles? How should it be constructed?

Must Be Strong

By C. S. Heritage

Bridge Engineer, Kansas City Southern, Kansas City, Mo.

Scaffolds are required to provide a place for workmen to stand while applying chord bolts and brace bolts, while cutting off piles, cutting out drift bolts in caps and other similar work. They are of simple construction, usually consisting of needle beams suspended on each side of the trestle to support scaffold planks across on each side of each bent. Needle beams can be of 4-in. by 6-in., 3-in. by 8-in., or other suitable timbers. Occasionally we use either 2½-in. or 3-in. second-hand pipe. Needle beams should be about 20 ft. long to permit placing planks on both sides of two adjacent bents simultaneously.

Where the scaffold can remain at a fixed height, the suspenders for the needle beams are made iron bars bent to form suitable hooks at the top and bottom, so that they can be hooked directly over the guard timbers with the needle beams placed in the lower hooks or stirrups. These suspenders can be placed or moved to new points quickly and, if properly constructed, are safe. For other work, such as bolting the sway bracing, where the scaffold must be raised and lowered, ropes are used to suspend the needle beams.

Scaffolds must have ample strength to carry the load, but be light enough to be handled and moved with reasonable ease. Safety is the most important factor in the design, erection and use of scaffolds, for which reason only first-class timbers, free from knots or other defects that might cause failure under sudden shock, should be used. All ropes must be in good condition and tied securely. Ends of scaffold planks should not extend far beyond the supporting needle beams to prevent the possibility that workmen, in stepping on the extension, will tilt them up and fall with them. They must also be secured against slipping off of the needle beams, either through the use of drop bolts on the outside of the needle beams or by nailing or lashing them to the beams.

Men Must Be Close to Work

By General Bridge Inspector

Since timber trestles span openings of varying depths, it becomes necessary to use scaffolding, except where the height is such that men can work from the ground. The nature of the structure also necessitates that the scaffolding be suspended rather than built from the ground up. The work that must be done from scaffolding includes the cutting off of piling, the installation of caps, the bolting of the chords and the placing of the sway, transverse and longitudinal bracing. The weight of the members to be handled, the necessity for accuracy in line and surface and the placing of the bolts in the several members demand close proximity to the work and a secure footing at all times.

In maintenance, the greater part of the work to be performed is on the deck, for which reason the scaffolding can be more simple than that required for construction. Obviously, in the erection of swinging scaffolds, the relative height of the scaffold should be so chosen that men will neither be required to reach too far nor to work under restricted headroom. Otherwise, they cannot work expeditiously or comfortably.

Scaffold hangers can be cable sling to place over the ends of caps, or between the ties with a bar across the ties and through the bight of the sling; or they can be forged rods bent to fit over the guard timbers, supporting the needle beams; or chains with grab hooks for adjustment.

The use of rope for suspending scaffolding has been discontinued on many roads, since the stretch in the line and both loose and tight knots tend to give unequal elevation to the ends or corners of the scaffold. Again, the possibility of accidental cutting or of being burnt by a carelessly thrown cigarette, thus dropping one end or

corner of the scaffold, have been factors in the elimination of rope hangers. To be safe, a scaffold must be level, have a smooth flat surface, and present an absence of teetering, for which reasons it is important that the hangers be of equal length.

On our road, all scaffolding appurtenances are inspected at intervals and immediately before use. Cold-bent hanger rods are not tolerated. All needle beams and scaffold plank are sawed from clear straight-grained spruce and are protected from the weather and potential damage from other sources when not in use. Instructions are specific that this lumber shall not be used for any purpose other than scaffolding. Every gang is provided with enough scaffolding material for several spans.

Planks that are warped, in wind or have become defective in other respects, must be cut up and used for other purposes. Promiscuous use of stock lumber in hanging scaffolds or for the decks of built-up scaffolds should be prohibited.

Are These Tolerances Better?

The present A.R.E.A. specifications for ties limit tolerances to nothing under and 1 in. over the specified dimensions. What are the advantages or disadvantages of this requirement, as compared with the former tolerances of 1 in. shorter and 2 in. longer; 1 in. thicker and ¼ in. thinner; and 3 in. wider and ¼ in. narrower than the specified dimensions?

All on the Advantage Side

By John Foley

Forester, Pennsylvania, Philadelphia, Pa.

All of the disadvantages of the older requirement are eliminated by the new specification. The net result for the railway which adheres to the specifications is the receipt of more ties which conform to the dimensions specified for the standard sizes. This means an average increase of at least ¼ in. in the thickness of the wood for wearing under the rail and in the width for bearing on the ballast. The increase in volume for the standard sizes is 6 per cent or more.

In general, ties are roughly made and rapidly handled. It is impracticable to measure every tie as it is inspected and provide for a tolerance fixed in degree or extent for slightly mis-manufactured ties. The per cent of error in an inspector's ocular determination of dimensions will result in some undersized ties regardless of the minima specified for length, thickness and width. Experience with the former specifications demonstrated that twice the acceptable tolerance was often permitted. The manufacturer aimed to take the whole tolerance but often actually took more, while the inspector overestimated the reduced dimensions no less than he would have done if they had been ¼ in. larger. For these reasons, ties that were accepted as Sizes 1, 2 and 3 were too often found to be only 5½ in. thick.

Ties that are no shorter than the length specified provide maximum bearing on the ballast, while limiting the oversize tolerance to 1 in. provides better appearance in the track and avoids interference with or injury to ballast-cleaning equipment.

Where the revised specifications are being adhered to, more care and less guesswork is being used in the measurement of the ties by those hewing or sawing and inspecting them. There has also been collateral improvement in the whole manufacturing process, which has resulted in the production of better ties.

Are Getting Better Ties

By District Engineer

Tie inspection has not always been as rigid as most trackmen have desired, for which reason many ties that were oversize in width or thickness, or both, have been accepted without the degrading required by the specifications. Where a latitude of 2¼ in. was allowed in the thickness, and particularly where the minimum was often "skinned," the insertion of the ties became a real problem. If a tie of maximum thickness was used to replace a thin one, the old bed had to be torn to pieces. If the situation was reversed, too much space was left to be filled and tamped. On the other hand, if the ties were sorted to avoid these difficulties, time was wasted and production was reduced.

Similar conditions arose with respect to the width. It was not uncommon to have a skimped tie adjacent to an oversized one, or several oversized or undersized ties in a group. It is obvious that under these conditions the rail could not be given a uniform bearing. Likewise, within the ordinary limits of tie length, the nearer this length approaches uniformity the easier it is to keep track in good surface, since any wide divergence affects the support for the rail, while an uneven tie line not only presents a poor appearance but interferes with ballast cleaning.

It is obvious, therefore, that close adherence to the specifications is of definite benefit to the track structure and that it tends to reduce the amount of labor necessary to maintain it.

Oil Versus Steam for Pumping

What are the relative advantages of steam and oil engines for pumping?

Steam Plants Obsolete

By J. H. Davidson

Water Engineer, Missouri-Kansas-Texas, Parsons, Kans.

Steam pumping plants for railway water supply are practically obsolete today. It is true that there are still many such plants in service, but they are survivors of the earlier days when oil engines and other power units for pump operation had not yet been brought to the stage of perfection which characterizes them today. Steam plants were then considered generally to be more reliable, more nearly "fool proof" and better suited to operation with unskilled labor than internal-combustion engines. Usually, whenever it now becomes necessary to replace one of these old steam plants or to make extensive repairs or alterations, oil engines or electric motors are installed as power units.

Very few new steam pumping stations are now being installed on the railways. On the other hand, where it is necessary to maintain a steam power plant, say, for heating or other purposes, the installation of a steam pump may be justified. Practically the only advantage that can be claimed for the steam pump as compared with an oil-engine driven pump is its greater flexibility, in that it is able to meet successfully a wider range of operating conditions than the other type.

Modern oil engines are generally

considered to be the most practical and economical power unit for the average railway water pumping stations. Among the many advantages this type of pumping unit has over the steam pump may be mentioned low installation costs, low fuel consumption, the minimum of maintenance, the smaller floor space required, convenience in handling and storing fuel and low maintenance costs.

Is a Matter of Economics

By Inspector of Water Stations

In the main, this question is purely one of economics. Most water engineers are prepared to say that the steam plant is obsolete for railway water pumping, and up to a certain point in the question I agree quite readily with them.

For instance, at an isolated water station of small demand, a steam plant, with its requirement for constant or nearly constant attendance, will bring the unit cost of the water consumed to an unreasonably high figure. This is aside from any question of relative fuel economy as between different types of power.

In such a situation it is generally far more economical to replace the steam plant with an oil engine and provide sufficient wayside storage capacity to reduce the attendance to short periods of pumping. Going a step further, if electric power is available at low rates, it may be still more economical to make the station fully or semi-automatic and eliminate attendance.

At the other extreme is the water station located at a terminal where there is a central power plant, thus making steam readily available at low cost. At such a point the water demand is likely to be sufficient to warrant regular attendance, so that little economy can be realized through the installation of other types of power units. Furthermore, if there is a large shop or other concentrated fire risk, steam-driven fire pumps are considered more dependable and flexible than other types. Where steam can be obtained from a central heating plant, it is quite likely that the plant attendant can look after the pumps, in which event steam pumps may be more economical than other types of power plants.

Between these two extremes there is a wide range of conditions. It has been my experience that in many instances greater economy can be obtained with the oil engine, but there are many others in which the steam pump offers the best solution to the problems that must be met. Even here, however, proximity to fuel supply may be a deciding factor, for it is obvious that a steam plant located in or near a coal field can be operated at lower cost than one for which the fuel must be given a long haul.

On the other hand, where there are wide variations in the pumping head and the consumption of water, the steam pump may be superior to other types because of its greater dependability and flexibility.

Inspecting Movable Spans

What details should be given particular attention when inspecting movable spans? What is the importance of each?

Many Items, All Important

By A. E. Bechtelheimer
Assistant Engineer of Bridges, Chicago & North Western, Chicago

In discussing this question, I will omit reference to the power plant and some of the primary operating machinery, although I consider them to constitute the most important features of a movable bridge. Certain parts, such as gears, clutches, brakes, bearings, etc., are too intimately connected with the design, operation and use of the bridge to be omitted, however. In general, the inspection of the structural features of a movable span does not differ greatly from that of a fixed span. It is particularly important, however, to observe the conditions at the bearing points at the ends of the span and, if the bridge is of the swinging type, on the turntable.

Lubrication is important in a movable span, and all moving parts should be examined to know that they are being kept lubricated properly. Observation of this feature should be made during operation. The operation of a movable bridge cannot be expected to be satisfactory or entirely dependable if there is lost motion in the operating machinery, for which reason special attention should be directed to the condition of the gears with respect to accurate meshing, the fit on the shaft, the fit of the keys and to excessive wear of any of the parts. An equally close inspection should be made of all bearings to determine whether they have a good running fit and whether the shafts are properly alined.

All castings should be inspected closely. This includes the wedges, locking devices, rollers, treads, etc. The same attention should be given to clutches and brakes to insure that the working conditions are satisfactory and that they are clean. In addition to the foregoing determinations, particular attention should be directed to the adjustment of the wedges or other lifting devices, to the turntables of swing bridges and to the condition of the interlocking facilities, navigation lights and other safety devices. It should also be observed whether the operating diagram is posted in the operator's house in accordance with instructions.

Special Features Only

By General Inspector of Bridges

Inspection of the structural members and connections of a movable span scarcely differs from that of a fixed span, but there are many special features, depending on the type, whether swing, bascule or vertical-lift, which must be given close attention. Obviously, the end bearing points of any movable span are highly important and should be inspected carefully at closure and under traffic. In this connection, special observation should be made of the condition and adjustment of wedges and turntable parts, condition of and tension in lifting cables and balance between counterweights and span.

All bearings should be examined for fit and wear and particular attention should be directed to the alinement of shafts. Of equal importance, the wear on and the meshing of gears should be noted, as well as the fit of gears and keys on their shafts.

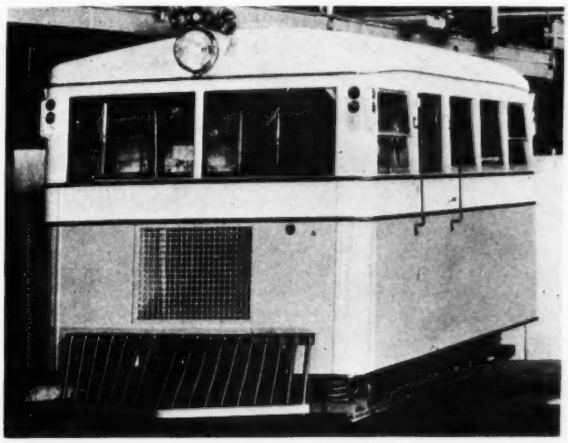
These items are particularly important because poor conditions at any or all of these places may have a serious effect on the operation of the span. This examination should include lubrication, for dry bearings may create large damage, particularly in the trunnion bascule type.

If brakes and clutches are defective, the operation of the span cannot be controlled properly and the bridge may be damaged or navigation delayed. For these reasons, they should be examined closely. Likewise, defects in the locking or interlocking devices may be equally hazardous. For the same reason, navigation lights should be known to be in good condition.

New and Improved Devices

Fairmont Motor Coach

THE Northern Pacific has purchased from Fairmont Railway Motors, Inc., Fairmont, Minn., a railway motor coach for inspection service, which differs from two cars which this road has had in service for more than a year in type of body although using the same chassis. In the new model the engine hood is located within the body while in the two models already in service, the hoods extend outside in front automobile-fashion.



The Fairmont 4100 Railway Motor Coach

The new unit, known as Model 4100, is similar to and intermediate in size between this company's Model 5100, a larger inspection car, and its lighter Model 3100 which was described in *Railway Engineering and Maintenance* for October, 1935. It has a capacity for 6 to 12 passengers, depending on the seating arrangement desired. It has an over-all length of 18 ft. 1½ in., an over-all width of 8 ft. 4 in., an over-all height above the rails of 8 ft. 4½ in., and headroom inside of 5 ft. 6 in. The floor space occupied by the engine housing is 30 in. by 60½ in. In order to reduce air resistance and lower the glare, the front and rear ends of the body are sloped inward at an angle of about 6 deg.

As delivered for inspection service, the Model 4100 is equipped with shatter-proof glass in the windshield, screens, curtains, storm sash, complete body insulation and two Tropic Air heaters. Other features include a long spring base and spring travel smoothed by two-way hydraulic shock absorbers; conveniently located doors, hand rails and running boards, which make it easy to enter and leave the car quickly; a 77-hp. Waukesha six-cylinder engine; Bendix vacuum power brakes of the clasp type on outside renewable drums; and Davis steel wheels, Timken bearings and trunnion-mounted axles. With reversible seats, four speeds forward or backward and the controls so situated as to be handy for the driver when facing in either directions, the car is completely reversible.

Bethanized Fence Wire

THE Bethlehem Steel Corporation, in connection with the formal opening of a new wire galvanizing unit at its Cambria plant, at Johnstown, Pa., on April 16, announced a new type of galvanized fence wire, produced by the electrolytic method, which is said to be highly superior in corrosion resistance, quality and appearance to galvanized wire produced by other methods. The method employed in the production of this wire is known as the Bethanizing process.

In this process, the wire is first electrolytically cleaned in a bath of molten caustic soda. The zinc is then applied to the surface of the wire by electro deposition out of a bath of purified zinc solution circulated through the electrolytic cells. There is no metallic zinc in this system except that which is deposited out of the solution on the wire as virgin metal.

It is claimed that the zinc deposited on the wire is spectroscopically pure, of a higher degree of purity than has ever before been produced, and that unlike ordinary zinc of less purity, it is extremely tough and ductile. It is also claimed that through the new process, the zinc is applied uniformly to any desired thickness, and that the bond between the electro-deposited zinc and the steel is so complete that it is impossible to separate the zinc from the wire by any mechanical distortion. In a finishing process given the wire, it is passed through dies which give it a smooth polished surface, which is not only pleasing in appearance, but which adds to its resistance to corrosion.

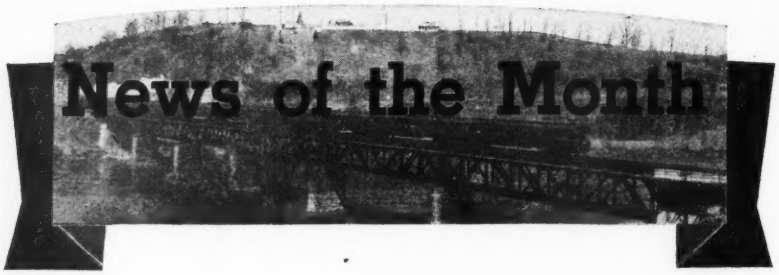
Through the qualities of toughness and ductility of the new pure zinc coating and the tight bond of the coating to the steel body of the wire, it is said that the finished wire can be fabricated into any type of fence without fear of injuring the coating in any way, and through the pureness of the coating metal and the uniformity with which it is applied, it is claimed that the life of Bethanized fence wire will far outserve other galvanized wire.

The new unit at the Cambria plant for producing Bethanized wire has two plating cells, each 110 ft. long, which take 40,000 amperes of current at normal load. Under ordinary conditions, 12 wires can be passed through each cell at a time, traveling at speeds from 50 to 200 ft. a minute, depending upon the size of the wire and the thickness of coating that it is desired to apply.

The Two New Electrolytic Cells at the Cambria Plant for the Production of Bethanized Fence Wire

---

FATALITIES AT CROSSINGS—During 1935, 1,600 persons were killed in accidents at highway-railroad grade crossings, as compared with 1,554 in 1934 and with still lower totals for the two preceding years, according to the Safety Section, Association of American Railroads. It is pointed out, however, that over a longer term there has been an improvement in the situation, as, up to 1930, there had not been less than 2,000 fatalities in any one year for eight years. In 1928 the total was 2,567.



Loadings Expected To Show Increase

Freight car loadings in the United States in the second quarter of 1936 are expected to be about 9.5 per cent above actual loadings in the corresponding quarter in 1935, according to estimates compiled by the thirteen shippers' regional advisory boards. On the basis of these estimates, loadings of the 29 principal commodities are expected to total 4,984,325 cars in the second quarter of this year, compared with 4,551,737 actual loadings of the same commodities in the same quarter of last year. All of the thirteen boards estimate that increases in railroad carloadings will take place in their respective regions in the second quarter of 1936, as compared with the same period in 1935.

Grade Crossing Program for 1938-9

A new program for the elimination of hazards at railroad-highway grade crossings is proposed by the Hayden-Cartwright bill now pending before Congress, which provides for federal appropriations of $50,000,000 for this purpose each year for the fiscal years 1938 and 1939. The bill provides for the separation or protection of grades at crossings, the reconstruction of existing railroad grade-crossing structures, and the relocation of highways to eliminate grade crossings. The program envisaged in this bill would go into effect on the completion of that which is now under way with the allotment of $200,000,000 of emergency relief funds, and the funds would be apportioned to the states in accordance with the same formula on which the distribution of the $200,000,000 was based. The bill has been passed by the House of Representatives but has not yet been taken under consideration by the Senate.

Additional Rail Orders

During April orders were placed by various railroads for a total of approximately 83,500 tons of rail, thus bringing the total tonnage ordered so far this year to 443,100 or nearly 90 per cent of the 490,300 tons ordered during the entire year of 1935. Among the larger orders for rails placed during the month was one for 25,000 tons of 112-lb. and 131-lb. rail placed by the Baltimore & Ohio with the Carnegie-Illinois Steel Corporation, the Bethlehem Steel Company, and the Inland Steel Company; one for 18,099 tons of 112-lb. and 131-lb. rail placed by the Erie with the same three companies; and one for 20,000 tons of 131-lb. rail which the Norfolk & Western placed with the Carnegie-Illinois Steel Corporation and the Bethlehem Steel Company.

Rail Income Shows Increase

For February the Class I railroads of the United States had a net railway operating income of $33,594,718, which was at the annual rate of return of 2.14 per cent on their property investment, as compared with a net of $26,296,411, or 1.67 per cent, in February, 1935, according to reports compiled by the Bureau of Railway Economics of the Association of American Railroads. Operating revenues for February amounted to $300,458,829, as compared with $254,927,060 in February, 1935, an increase of 17.9 per cent. Operating expenses in February totaled $235,906,241 compared with $199,585,654 in the same month in 1935.

For the first two months of the year these lines had a net railway operating income of $69,359,466, or 2.33 per cent, as against $48,236,651, or 1.61 per cent, in the corresponding period of 1935. Operating revenues for the first two months amounted to $599,557,505, as compared with $519,126,933 for the same period in 1935, an increase of 15.5 per cent. Operating expenses totaled $467,684,885 as compared with $411,995,188, an increase of 13.5 per cent.

Suspends Eastern Store-Door Tariffs

Acting on protests filed by trucking interests, the Interstate Commerce Commission recently voted to suspend for seven months the tariffs which have been filed by Eastern railroads generally providing for free store-door pick-up and delivery service on l.c.l freight and which were to become effective on April 1. At the same time it voted not to suspend similar tariffs which were put into effect recently by the western and southern lines. During the seven-month period the commission plans to conduct an investigation of the rates.

The suspension was voted after the commission had listened to oral arguments filed by the American Trucking Associations, Inc., the Merchant Truckmen's Bureau of New York, and other trucking representatives who contended the plan of free store-door service represented an effort on the part of the railroads to meet truck competition by performing service at a loss. It was pointed out that the railroads were making contracts for performing the pick-up and delivery service with new organizations of truckers other than those who had been performing the service for shippers and that this would have a ruinous effect on the existing local truckers. Some of the protestants also contended that the allowance of 5 cents a hundred pounds proposed by the railroads for shippers and consignees who elect to furnish the pick-up and delivery service for themselves would amount to a rebate, but it was also argued by others that the allowance was so small that few shippers would employ local truckers to perform the transfer service for them.

To Construct 111-Mile Line

The Atchison, Topeka & Santa Fe has awarded a general contract to the Sharpe & Fellows Company, Los Angeles, Cal., for the construction of 111.25 miles of single track railroad between Boise City, Okla., and Las Animas, Colo. This is the largest new line construction project that has been undertaken since 1931. The new line will form part of a new route, between Texas and Colorado points, involving the building of a line between Amarillo, Tex., and Las Animas, that portion of the line from Amarillo to Boise City having been completed in May, 1931. The portion between Boise City and Las Animas will be constructed of 90-lb. No. 1 second-hand rail, of which 17,000 tons will be required, treated pine ties and ballast of native materials. Grading quantities will include 3,000,000 cu. yd. of embankment, 760,000 cu. yd. of common excavation, 109,000 cu. yd. of loose rock excavation and a total of 400,000 cu. yd. of solid rock excavation.

World's Speed Record

The world's record in train speeds achieved with standard railway equipment is held by an American railroad, according to a recently published tabulation. The record, 127.2 miles per hour, was made in 1905 by the Pennsylvania Special, now the Broadway Limited, of the Pennsylvania on its first run on an 18-hr. schedule between New York and Chicago, this speed being attained when the train covered the three miles between AY Tower, Ohio, and Elida in 1 min., 25 sec. This speed compares with records of 119 m.p.h. in Germany, 115.6 m.p.h. in France and 112 m.p.h. in England. However, some exceptionally fast records were established in this country even prior to 1905. As early as 1892, a Central of New Jersey train established a world's record for speed when it covered one mile in 37 seconds, or at the rate of 97.3 m.p.h. In the following year this record was surpassed by a New York Central train which traversed a mile in 32 sec., or at an average speed of 112.5 m.p.h. This record stood until 1903, when the Pennsylvania General Manager's Special, a two-car train, covered 6.2 miles in 3 min., or at the rate of 124 m.p.h. Two years later the Pennsylvania established the record of 127.2 m.p.h., which still remains unbroken.

Association News

Maintenance of Way Club of Chicago

A total of 125 members and guests attended the meeting of the club on April 27 which completed the fifteenth year of this club's activities. The following officers were elected: President, E. J. Brown, roadmaster, Chicago, Burlington & Quincy; first vice-president, W. G. Arn, assistant engineer, Illinois Central; and second vice-president A. B. Hillman, roadmaster, Belt Railway of Chicago. W. S. Lacher was re-elected secretary and treasurer. The business meeting was followed by entertainment supplied by a number of vaudeville and radio artists.

Metropolitan Track Supervisors' Club

Sixty members and guests were present at the meeting of the Metropolitan Track Supervisors' Club at the Hotel McAlpin, New York, on April 23. Following dinner at 6:30 p.m., the meeting was addressed by Col. A. L. Bartlett, engineer maintenance of way, New York, New Haven & Hartford, who described the new track maintenance organization on the New Haven, which does away with section forces and provides highway motor trucks for the movement of all heavy maintenance gangs, as described in the December, 1935, issue of *Railway Engineering and Maintenance*. More than an hour of active discussion followed Col. Bartlett's remarks.

American Railway Engineering Association

Only one committee, that on Economics of Railway Operation, met in April, convening at Chicago on April 2. Seven committees have meetings scheduled for May and two others are planning to meet during the month, but have not yet set dates. Those now scheduled are Water Service, Fire Protection and Sanitation, on May 5, at Chicago; Buildings, at Buffalo, N. Y., May 5 and 6; Track, at Chicago, on May 6; Iron and Steel Structures, at Cleveland, Ohio, on May 6 and 7; Waterways and Harbors, at Chicago, on May 7; Rail, at New York, on May 8, and Economics of Railway Labor, at Chicago, on May 28, and St. Paul, Minn., on May 29. Those committees which have not yet definitely scheduled meetings in May are Masonry and Maintenance of Way Work Equipment. The Board of Direction also has a meeting scheduled to take place at Chicago on May 20.

Beginning on April 25, when the first letter was mailed, President Wilson has instituted a series of letters which will go to the members of the Board periodically, transmitting a synopsis of all important matters which are likely to come up for consideration, to the end that every member will be informed currently concerning these subjects.

Personal Mention

General

C. C. Cunningham, division engineer of the Kansas-St. Louis division of the Chicago, Rock Island & Pacific, with headquarters at Kansas City, Mo., has been promoted to superintendent of the Cedar Rapids-Dakota division, at Cedar Rapids, Iowa.

J. R. Watt, engineer maintenance of way of the Louisville & Nashville, who has been appointed assistant purchasing agent, as announced in the April issue, has been connected with the engineering and maintenance of way departments of the Louisville & Nashville for more than 30 years. He was born on April 16, 1884, at Greenfield, Ohio, and attended Salem Academy, South Salem, Ohio, and later the University of Ohio. He entered rail-

J. R. Watt

way service in August, 1905, as a rodman on the Louisville division of the L. & N., serving as instrumentman and assistant engineer on the Cumberland Valley and Louisville divisions, as assistant engineer at Birmingham, Ala., and for a short time in the chief engineer's office at Louisville. In 1914, he was promoted to roadmaster of the Nashville division, which position he held until 1917, when he was further advanced to general roadmaster, with headquarters at Louisville. On February 15, 1932, Mr. Watt was advanced to engineer maintenance of way, which position he held until his recent appointment. His headquarters remain at Louisville.

J. S. Bassett, assistant superintendent on the Missouri Pacific, who was connected with the engineering department of this company for many years, has been appointed superintendent of the Little Rock-Louisiana division, with headquarters at Monroe, La. Mr. Bassett was born on August 13, 1886, and received his higher education at Iowa State College, Ames, Iowa. Except for two years during the World War when he served in the United States army, Mr. Bassett has been connected with the Missouri Pacific continuously since 1909. He entered the service in that year as an assistant on the engineering corps at St. Louis, Mo., and later served as a building inspector at Nevada, Mo. In 1912, he was appointed assistant engineer and served in this capacity at various points until 1917, when he joined the army. In July, 1919, Mr. Bassett returned to the Missouri Pacific as assistant engineer, being advanced to division en-

J. S. Bassett

gineer in 1923, which position he held until December, 1929, except for a period during 1924, when he served as assistant division engineer and another period during 1928, when he served as master of trains and track. In 1929, he was transferred to the operating department as assistant superintendent, serving in this capacity and as trainmaster and acting superintendent until his recent appointment as superintendent, effective March 1.

Elmer H. Brown, bridge and building supervisor on the Northern Pacific at Minneapolis, Minn., has been appointed superintendent of the Northern Pacific's general office building at St. Paul, Minn., succeeding **A. V. Fabian,** who has retired.

Charles Shalter Krick, vice-president of the Eastern region of the Pennsylvania, with headquarters at Philadelphia, Pa., and an engineer by training and experience, has retired from active duty. Mr. Krick was born at Reading, Pa., and after graduation from Lafayette college in 1887 with a degree in civil engineering, he entered the service of the Pennsylvania as a rodman. Three years later he was appointed assistant supervisor of track, holding this position at various points until June, 1896, when he was appointed supervisor, in which position he served consecutively on the Schuylkill, Middle and Pittsburgh divisions. Mr. Krick was appointed division engineer of the Eastern and Susquehanna divisions in January, 1903, being transferred to the Philadelphia Terminal division in August, 1903. In January, 1906, he was advanced to principal assistant engineer of the Philadelphia, Baltimore & Washington at Wilmington, Del. He was appointed division superintendent in August, 1910, and in November, 1915, he was made acting general superintendent of the New Jersey general division and the West

Jersey & Seashore. In May, 1916, Mr. Krick became general superintendent of those lines. He was advanced to assistant general manager of the Eastern lines of the Pennsylvania in July, 1918, under

Charles Shalter Krick

the United States Railroad Administration, and upon the termination of federal control in March, 1920, he became general manager of the Eastern region at Philadelphia. Mr. Krick served in that capacity until October, 1923, when he was appointed vice-president of the Eastern region, which position he held until his retirement.

Engineering

A. O. Gustafson, who has been connected with the engineering and maintenance of way departments of the Chicago, Rock Island & Pacific for many years, has been appointed chief clerk to the chief engineer at Chicago, succeeding **A. P. Cone,** who has retired.

H. M. Long, roadmaster on the Chicago, Rock Island & Pacific at Cedar Rapids, Iowa, and formerly division engineer on this road, has been promoted to division engineer of the Kansas-St. Louis division at Kansas City, Kan., succeeding **C. C. Cunningham,** whose promotion to superintendent is noted elsewhere in these columns.

C. J. Carney, supervisor of trains and track on the Illinois Central, with headquarters at Greenville, Miss., has been appointed acting division engineer of the Vicksburg division, with headquarters at Vicksburg, Miss., to replace **J. M. Harper,** who has been granted leave of absence because of ill health.

G. R. Haworth, division engineer of the Western Maryland, with headquarters at Cumberland, Md., has been promoted to engineer maintenance of way, with headquarters at Baltimore, Md., succeeding **C. B. Hoffman, Jr.,** who has been assigned to other duties.

A. H. Morrill, assistant chief engineer of the Boston & Maine and the Maine Central, with headquarters at Portland, Me., has been appointed acting chief engineer of these roads. **William J. Backes,** chief engineer, has been granted a leave of absence on account of ill health.

Edward Wise, Jr., assistant division engineer on the Louisville & Nashville, with headquarters at Pensacola, Fla., and formerly a division engineer on this road, has been promoted to division engineer of the Evansville division, with headquarters at Evansville, Ind., effective April 1, to succeed **L. L. Adams,** whose promotion to engineer maintenance of way was noted in the April issue. **W. G. Thompson,** assistant engineer at Mobile, Ala., has been promoted to assistant division engineer at Pensacola, to replace Mr. Wise and **R. E. Nottingham,** supervisor of track at the Nashville (Tenn.) terminals, has been appointed assistant engineer with headquarters at Mobile, to succeed Mr. Thompson.

Frank P. Filippelli, whose promotion to assistant division engineer on the Pennsylvania, with headquarters at Baltimore, Md., was announced in the February issue, was born on March 17, 1893, at Harrisburg, Pa. He was graduated from Pennsylvania State College in 1915, and entered railway service on May 1, 1917, as a draftsman on the Pennsylvania, with headquarters at Harrisburg. On August 1 of that year he was promoted to rodman with the same headquarters, and on May 1, 1918, he was promoted to transitman at Philadelphia. On June 20, 1918, he was promoted to assistant supervisor of track, with headquarters at Titusville, Pa., and subsequently served in this capacity at Columbia, Pa., Bordentown, N. J., and Baltimore, Md., until November 10, 1928. On this date he was promoted to supervisor of track, with headquarters at Jamesburg, N. J., and later served in this capacity at Jersey City and Trenton, N. J., and at New York City. He was located at New York at the time of his recent promotion to the position of assistant division engineer.

Thomas M. Pittman, whose appointment as division engineer of the Mississippi division of the Illinois Central with headquarters at Water Valley, Miss., was announced in the April issue, has been connected with this road for about 30 years. He was born on August 14, 1887, at Henderson, N. C., and received his civil engineering education at the University of Illinois. He entered the service of the Illinois Central in August, 1905, as a track apprentice, being promoted to rodman in July of the following year. In November, 1906, Mr. Pittman was advanced to instrumentman, serving in this position on the Yazoo & Mississippi Valley (a unit of the I. C. System) at Memphis, Tenn., until September, 1908, when he took a leave of absence to attend the University of Illinois. He returned to the Illinois Central in October, 1911, as a rodman at Fulton, Ky., being appointed instrumentman at the same point in June, 1912. On October 1, 1915, he was advanced to assistant engineer, serving in this position at Chicago and at McComb, Miss., until June, 1921, when he was appointed division engineer at Water Valley. In October, 1931 he was returned to the position of assistant engineer, serving in this position until his recent reappointment to the position of division engineer.

L. L. Adams, whose appointment as engineer maintenance of way of the Louisville & Nashville, with headquarters at Louisville, Ky., was noted in the April issue, has been connected with the L. & N. for 25 years. Mr. Adams received his higher education in Kentucky State University, graduating with a degree in civil engineering in 1911. He entered the service of the L. & N. in May of the same year as a rodman in the construction department, serving in this position and as an inspector, assistant resident engineer and resident engineer until May, 1913. At that time he entered the office of the chief engineer as draftsman, and after a year in this capacity he was appointed assistant engineer on maintenance, with headquarters at Nashville, Tenn. In May, 1917, Mr. Adams enlisted in the United States Army, being commissioned a captain and serving in France with the Eighty-second Division, Engineers for 11 months. On July 9, 1919, he returned to the L. & N., as an assistant engineer in the chief engineer's office, being appointed headquar-

L. L. Adams

ters supervisor in the roadmaster's office at Ravenna, Ky., on October 1 of the same year. In July, 1920, he was promoted to roadmaster, with headquarters at Etowah, Tenn., and was transferred to Louisville, Ky., on February 1, 1925. He was advanced to division engineer, with headquarters at Evansville, Ind., on July 1, 1931, which position he was holding at the time of his recent promotion.

Track

A. S. Boulding, a section foreman on the Canadian National at Saskatoon, Saskatoon, Sask., has been appointed roadmaster on the Prince Albert division at Prince Albert, Sask., succeeding **J. C. Wrixon,** who has retired.

M. A. Youngblood has been appointed road supervisor on the Illinois Central at Greenville, Miss., succeeding to a portion of the duties of **C. J. Carney,** supervisor of trains and track, whose appointment as acting division engineer is noted elsewhere in these columns. The position of supervisor of trains and track at Greenville has been abolished.

(Continued on page 318)

VERONA TRACK TOOLS

Sixty-three years' experience in making track tools gives the Woodings-Verona organization an unexcelled background for selecting the proper steels and for utilizing the best methods of manufacture and heat treatment.

As an added precaution, to insure the perfect condition of Verona Track Tools, each tool is checked by the *Verona Electric Polarizing Process* before leaving the shop.

Use Verona Track Tools for Economy and Safety

WOODINGS-VERONA TOOL WORKS

VERONA, PENNA.

SINCE 1873 SINCE 1873

L. Lowe, assistant engineer on the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Ottumwa, Iowa, has been appointed roadmaster on the Terre Haute division, with headquarters at Terre Haute, Ind., succeeding **E. Schoech,** who has been assigned to other duties.

G. A. McRoberts, assistant to the roadmaster on the Southern at Somerset, Ky., has been appointed track supervisor, with headquarters at Ludlow, Ky., succeeding **J. G. Woodall,** whose appointment as bridge and building supervisor is noted elsewhere in these columns. **R. J. Stone** has been appointed assistant to roadmaster at Somerset, to replace Mr. McRoberts.

R. A. Brown, a track inspector on the the Chicago, Rock Island & Pacific, has been appointed roadmaster at Cedar Rapids, Iowa, succeeding **H. M. Long,** whose appointment as division engineer is noted elsewhere in these columns. **F. A. Williams,** also a track inspector, has been appointed roadmaster at Polo, Mo., to succeed **H. B. Cassidy,** who has been assigned to other duties.

George M. Brum, whose appointment as roadmaster on the Chicago, Rock Island & Pacific at Haileyville, Okla., was announced in the March issue, was born on March 22, 1896, at Iowa City, Iowa, and was educated in civil engineering at the State University of Iowa. He entered railway service in June, 1917, as a chainman on the Rock Island, later serving successively as a rodman and transitman. In 1924 he was appointed a building inspector, working out of the chief engineer's office at Chicago, which position he held until April, 1927, when he was made a general foreman in the track department. In September of the same year Mr. Brum was advanced to roadmaster, which position he held until March, 1933, when he was appointed a track inspector. He was holding the latter position at the time of his recent reappointment as roadmaster.

Stanley A. Temple, whose appointment as supervisor of track on the Baltimore & Ohio, with headquarters at Lima, Ohio, was noted in *Railway Engineering and Maintenance* for March, was born on September 18, 1896, at Lexington, Ky., and first entered railway service in 1914 with the Chesapeake & Ohio, serving in various clerical positions and as a fireman. In May, 1916, he went with the San Antonio & Aransas Pass as a rodman, leaving this company in April, 1918, to become a transitman on the Pittsburgh & West Virginia at Pittsburgh, Pa. He served in this position until September, 1920, except from the period from June to November, 1918, when he was engaged in other work. In September, 1920, Mr. Temple went with the Baltimore & Ohio as an assistant engineer at Dayton, Ohio, later serving in the same position at Cleveland, Ohio. In February, 1922, he obtained a leave of absence from this road to serve as city engineer of Paintsville, Ky. From November, 1923 to June, 1924, he attended college and in October of the latter year he returned to the Baltimore & Ohio as an assistant engineer in the office of the engineer maintenance of way at Cincinnati, Ohio. He was holding the latter position at the time of his recent appointment as supervisor of road.

Bridge and Building

G. E. Brooks has been appointed master carpenter on the Chicago, Rock Island & Pacific, with headquarters at Rock Island, Ill., with jurisdiction over the Chicago terminals and the Illinois division.

B. W. Merrill, an assistant engineer on the New York, Chicago & St. Louis, has been promoted to the newly-created position of assistant supervisor of bridges and buildings, with headquarters at Conneaut, Ohio.

Glenn J. Morgan has been appointed general foreman of bridges and buildings and water service of the Eastern and Kansas City divisions of the Atchison, Topeka & Santa Fe, with headquarters at Emporia, Kan., to succeed **Andy J. James,** whose retirement was announced in the April issue.

J. G. Woodall, track supervisor on the Southern with headquarters at Ludlow, Ky., has been appointed bridge and building supervisor, with headquarters at Lexington, Ky., succeeding **E. H. Nutt,** who has been transferred to the St. Louis-Louisville division at Princeton, Ind., where he replaces **L. B. Craig.** Mr. Craig has been transferred to Somerset, Ky., to succeed **D. B. Brosnan,** who has been appointed a trainmaster.

David E. Saurer, who has been appointed master carpenter of the Ft. Wayne, division of the Pennsylvania, with headquarters at Fort Wayne, Ind., as noted in the March issue of *Railway Engineering and Maintenance,* was born on November 10, 1890, at Orrville, Ohio. Mr. Saurer received his higher education at Ohio Northern University, graduating with a degree in civil engineering in 1914. He entered railway service with the Pennsylvania on March 27, 1916, as an assistant on the engineering corps on the Ft. Wayne division. On November 16, 1923, he was promoted to assistant master carpenter of the same division, holding this position until June 1, 1930, when he was advanced to master carpenter of the Chicago Terminal division. On May 1, 1932, he returned to the Ft. Wayne division as assistant master carpenter, which position he was holding until his recent appointment as master carpenter of that division.

Thomas H. Harrington, whose promotion to bridge and building master on the Canadian National, with headquarters at Montreal, was announced in the March issue, was born in Westmorland, England, and received his education in the public schools. He entered railway service in July, 1913, as a masonry foreman on the Grand Trunk, with headquarters at Toronto, and left the service in 1915 to join the army with the Royal Engineers. Following active service at the front for several years, he re-entered the service of the Canadian National in 1924 as a mason, and in 1929 was promoted to gunite foreman. In 1931 he was promoted to general masonry foreman, which position he was holding at the time of his recent promotion to bridge and building master with headquarters at Montreal.

Obituary

Richard Walsh McEwan, president and chief engineer of the Morristown & Erie, with headquarters at Whippany, N. J., died on April 15 at his home in that city.

Onward Bates, formerly engineer and superintendent of bridges and buildings of the Chicago, Milwaukee, St. Paul & Pacific, died on April 4 at his winter home at Augusta, Ga. While Mr. Bates has been out of active railroad service for 35 years, he was widely known for his subsequent record as a railroad contractor and as a consulting engineer. He was born on February 24, 1850, in St. Charles County, Mo., and received his engineering education at Rensselaer Polytechnic Institute. While Mr. Bates did not finish his course at that time, he later received the honorary degrees of civil engineer from the University of Wisconsin, doctor of engineering from Rensselaer Polytechnic Institute and LL.D. from the University of Missouri.

Onward Bates

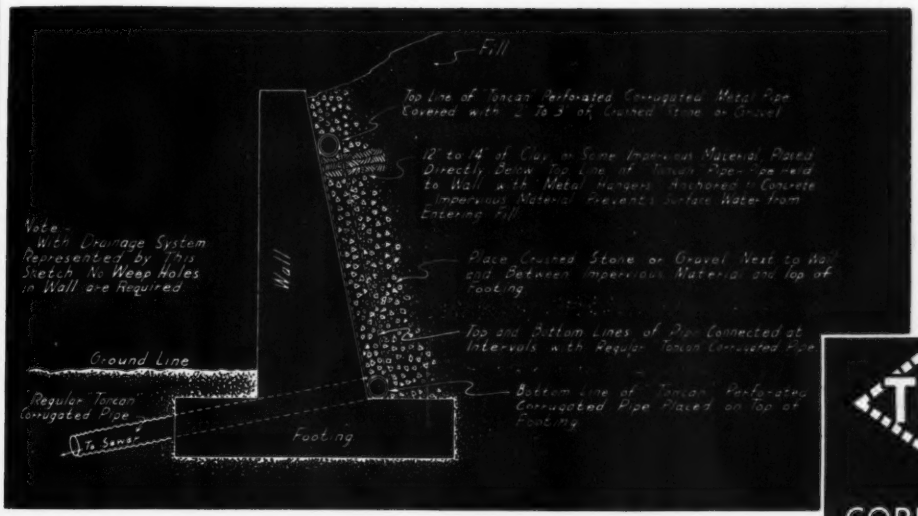
Early in his career, Mr. Bates served in engineering capacities with various concerns. His first railway service was with the Cincinnati Southern (now part of the Southern). Subsequently he was connected with the Edge Moor Iron Works and still later with the Pittsburgh Bridge Company. In 1888 he went to the Chicago, Milwaukee, St. Paul & Pacific as engineer and superintendent of bridges and buildings, holding this position until 1901, when he left this company to assist in the organization of the Bates & Rogers Construction Company, engineering and contracting firm of Chicago, of which he became president. In 1907 Mr. Bates retired although he continued for about 10 years to devote a limited amount of time to private consulting engineering work. Mr. Bates was active in the affairs of various technical associations and was a past-president (1909) and an honorary member (1923) of the American Society of Civil Engineers, and also past-president (1899) of the Western Society of Engineers.

(Continued on page 320)

USE...

TONCAN IRON CORRUGATED PIPE

TO DRAIN TRACK ELEVATION PROJECTS


Fill
Top Line of Toncan Perforated Corrugated Metal Pipe Covered with 2 To 3' of Crushed Stone or Gravel
12 to 14" of Clay or Some Impervious Material Placed Directly Below Top Line of Toncan Pipe—Pipe Held to Wall with Metal Hangers Anchored in Concrete
Impervious Material Prevents Surface Water from Entering Fill
Note: With Drainage System Represented by This Sketch, No Weep Holes in Wall are Required
Wall
Place Crushed Stone or Gravel Next to Wall and Between Impervious Material and Top of Footing
Top and Bottom Lines of Pipe Connected at Intervals with Regular Toncan Corrugated Pipe
Ground Line
Bottom Line of Toncan Perforated Corrugated Pipe Placed on Top of Footing
Regular Toncan Corrugated Pipe
To Sewer
Footing

TONCAN
COPPER MOLYBDENUM
IRON
CORRUGATED PIPE

When track elevation requires a retaining wall, provision for adequate drainage facilities is essential. The fill back of the retaining wall will act as a huge basin for collecting water unless facilities are provided for handling this condition. Water standing in the roadbed will make the track soft, destroy good line and surface, and make a bad riding track. In the winter, the roadbed freezes, and if sufficiently impregnated with water will cause incalculable damage to the retaining wall. Toncan Iron Corrugated Pipe used as shown in the sketch provides an exceptionally satisfactory solution to this problem.

Toncan Corrugated Perforated Pipe possesses the necessary inherent strength to withstand tremendous superimposed loads; flexibility to resist frost and ice action, vibration from traffic and shrinkage of fill material. It is light in weight, available in long lengths and easy to install. The perforations in every corrugation insure rapid collection of water and proper drainage.

Toncan Iron, an alloy of refined iron, copper and molybdenum, is well known for its flexibility, long life in service and its great resistance to rust. Specify Toncan Iron Corrugated Pipe and reap the benefits—lower cost per year of use—more dependable drainage—lower cost of roadbed upkeep.

TONCAN CULVERT MANUFACTURERS' ASSOCIATION

REPUBLIC BUILDING **CLEVELAND, OHIO**

TONCAN IRON—A PRODUCT OF THE REPUBLIC STEEL CORPORATION

Supply Trade News

General

The offices of the **P. & M. Company, Poor & Company,** the **Maintenance Equipment Company,** and the **Rail Joint Company** have been moved from 165 Broadway to 50 Church street, New York.

The Republic Steel Corporation has appointed the **Equitable Equipment Company, Inc.,** New Orleans, La., distributor of its ENDURO stainless steel. **The York Corrugating Company,** York, Pa., and the **Sheet Metal Manufacturing Company, Inc.,** Stamford, Conn., have been appointed Toncan Iron sheet distributors. The latter company is a branch of the same firm in Brooklyn, N. Y., which had previously been appointed distributors of Toncan sheets.

After seven years of investigation and research, the **Bethlehem Steel Corporation** formally announced on April 21 its new patented process of rail manufacture, known as "controlled cooling." This process, which as the name implies, controls the rate of cooling of the rails in the final process of their manufacture, is designed to relieve the internal stresses common in ordinary rails. More than 200,000 tons of the new type rails have been installed during the last five years, without a reported failure, and the company now intends to use its process on a quantity production basis.

Personal

Herbert N. West, manager of engineering and works of the **Weir Kilby Corporation,** Cincinnati, Ohio, has been elected a vice-president and will have charge of engineering and manufacturing at the

Herbert N. West

company's plants in Cincinnati and Birmingham, Ala. Mr. West entered the employ of the Weir Frog Company as a co-operative student six months prior to his graduation in civil engineering from the University of Cincinnati in 1920. He was promoted to chief engineer on October 1, 1921, and thence to chief engineer and works manager on September 1, 1923. In 1925, when the Weir Frog Company was consolidated with the Kilby Frog & Switch Company to form the Weir Kilby Corporation, Mr. West was made manager of engineering and works of the consolidated company, which position he held until his recent election as vice-president.

W. V. Peters, district sales manager for the **Truscon Steel Company** at Cleveland, Ohio, has been appointed manager of this company's steel window and door department. Mr. Peters entered the service of the Truscon Steel Company 17 years ago as a sash salesman in the Cleveland office. Subsequently, he was promoted to manager of the steel sash and door department at Detroit, Mich., then being appointed special representative, with headquarters at Philadelphia, Pa. His next appointment was to the position of district sales manager, which position he was holding at the time of his recent promotion.

E. E. Pershall, president of the **T. J. Moss Tie Company,** St. Louis, Mo., has been elected chairman of the board of directors. **John S. Penney,** vice-president of this company, has been elected president to succeed Mr. Pershall. **R. M. Hamilton,** vice president of **D. B. Frampton & Company,** Pittsburgh, Pa., and **Meyer Levy,** superintendent of production of the T. J. Moss Tie Company, have been elected vice-presidents of the latter company.

E. E. Pershall

Mr. Pershall was born in East St. Louis in 1888 and graduated from the University of Illinois in 1910, after majoring in chemical engineering. Upon graduation he entered the employ of the Kettle River Company, at Madison, Ill., with which company he continued until 1918, when he resigned as superintendent to become assistant to the president of the T. J. Moss Tie Company at St. Louis. In 1919 he was elected vice president, and in 1928 president of that company, which latter position he has held until his recent election. During his connection with the company Mr. Pershall has been active in the management of all phases of the company's operations. Mr. Pershall has been active in co-operative work in the tie industry, being one of the organizers of the National Association of Railroad Tie Producers, now the Railway Tie Association, in 1919, and serving as its president in 1931.

Mr. Penney was born in St. Louis, Mo., in 1890, and graduated from Westminster College, Fulton, Mo., in 1911, of which institution he is now chairman of the executive committee of its board of trustees. He became connected with the Kettle River Company upon graduation and resigned in 1918 to construct and operate the wood preserving plant of the Central Creosoting Company at Finney, Ohio. In

John S. Penney

1920 he entered the employ of the T. J. Moss Tie Company as general superintendent of timber treating plants and supervised the construction of its wood preserving plants at East St. Louis, Ill., and Granville, Wis. Later he directed the construction of plants at Bossier City, La., and Columbus, Miss. He was elected vice-president of the T. J. Moss Tie Company in 1928, which position he has held until his recent promotion. He has long been prominently identified with the activities of the American Wood Preservers Association, and served as its president in 1931.

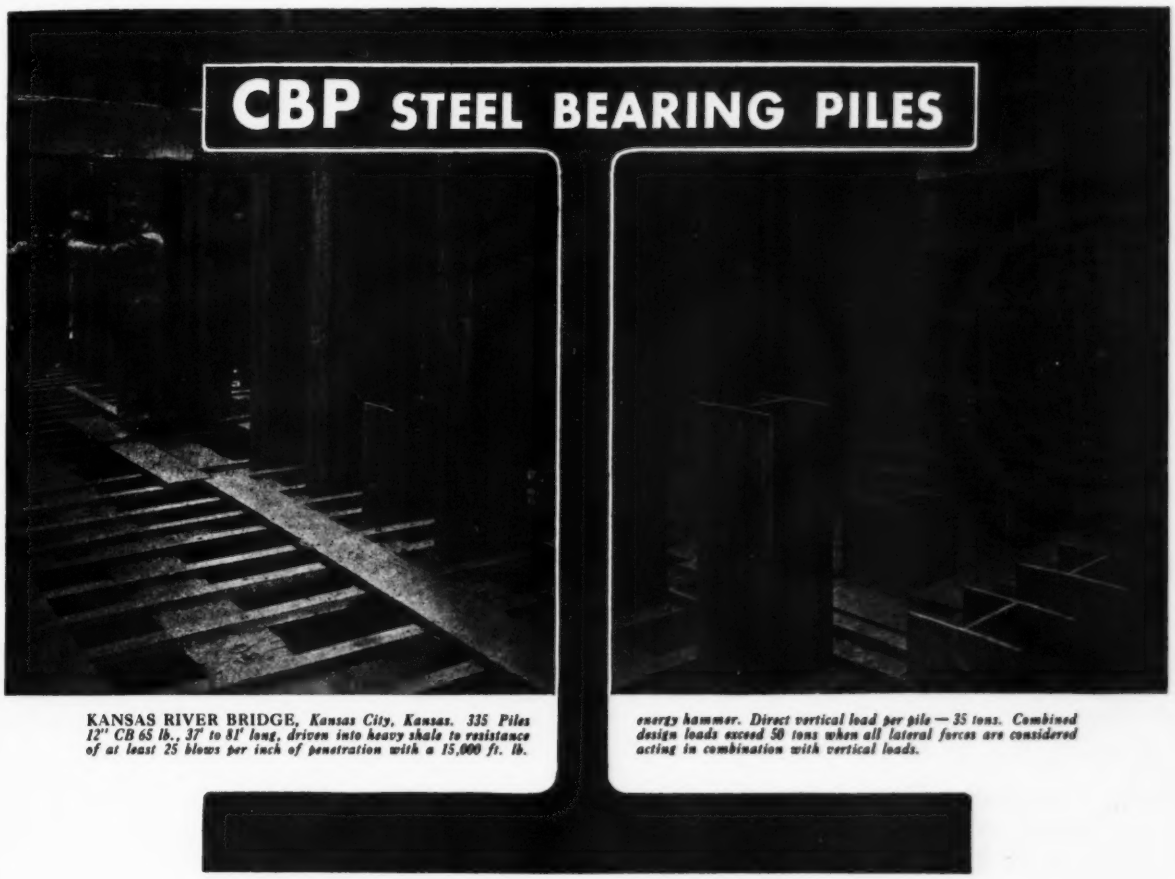
Robert T. Woodings, assistant to the president of the **Woodings-Verona Tool Works,** Verona, Pa., has been elected vice-president of that company. Mr. Woodings was born at Pittsburgh, Pa., on November 10, 1901, and graduated from the course of business administration at Bucknell University in 1925. Following graduation he entered the service of the Woodings Forge & Tool Company as an employee in the plant. Two years later he entered the sales staff of this company. Upon the acquisition of the Verona Tool Works in 1931, he was made assistant to the president.

William W. Watkins, president of the Joyce-Watkins Company, Chicago, died in Memphis, Tenn., on March 26 of pneumonia.

Charles L. Strobel, Sr., formerly a prominent consulting engineer and contractor in the railroad field, died on April 4 at his home at Chicago.

Charles B. Griffin, a representative of the Rail Joint Company, with headquarters at Chicago, died of diabetes on April 4 at the West Suburban hospital, Oak Park, Ill. (a suburb of Chicago).

When the call is for STRENGTH



KANSAS RIVER BRIDGE, *Kansas City, Kansas. 335 Piles 12" CB 65 lb., 37' to 81' long, driven into heavy shale to resistance of at least 25 blows per inch of penetration with a 15,000 ft. lb. energy hammer. Direct vertical load per pile — 35 tons. Combined design loads exceed 50 tons when all lateral forces are considered acting in combination with vertical loads.*

OR when you want prompt and assured shipment from an unfailing, dependable, convenient source of supply — specify CBP Steel Bearing Piles.

To the bridge and structural engineer, these sturdy steel sections— especially designed for efficient use as bearing piles — offer strength for any loading condition. Due to the rigidity and stiffness of steel, no cushioning is necessary at the top of the pile and virtually all of the energy of the driving ram is available at the pile point for securing penetration. This insures faster and easier driving. Desired penetration can be obtained under conditions so severe that other types are unusable.

Greater capacity per pile permits use of fewer piles — reduces the size and cost of coffer dams proportionately — requires less excavation for footings. Spliced lengths over 120 feet for permanent structures and up to 175 feet for falsework purposes have already been handled successfully and economically.

If your foundation problems demand that heavy loads must be carried on individual piles... if the pile must resist high bending stresses... if substantial bottoms are difficult of access... if the scouring effects of stream-borne sand and rock must be guarded against... CBP Bearing Piles insure lasting and economical construction.

Large stocks in all sizes are carried at our mills. There is no waiting for shipment of your order.

GET THIS BOOK ON CBP STEEL BEARING PILES

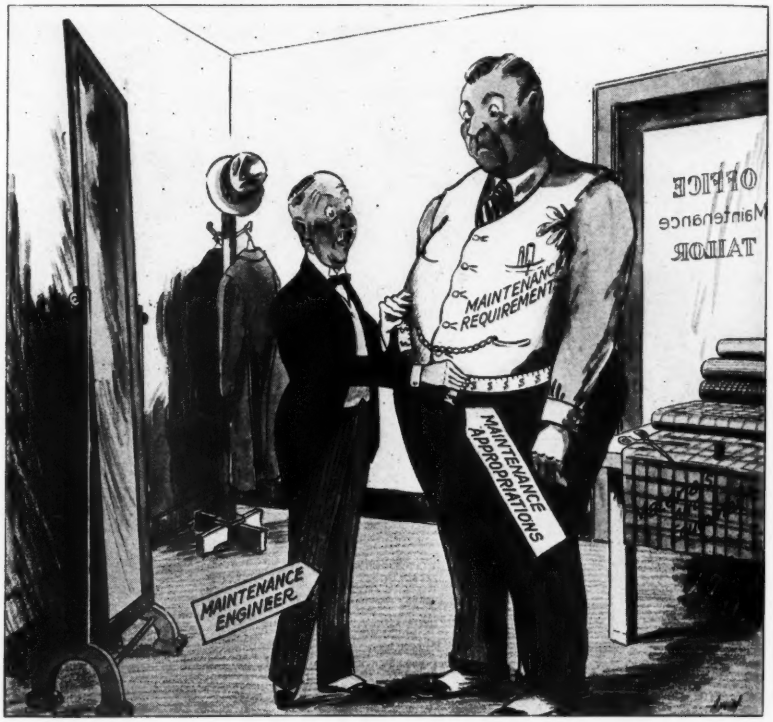
Have you a copy? The first book of its kind ever published. 80 data-filled pages. Facts, figures and practical information never before generally available. Entirely new material based on recent tests. Send for this book. It's worth your careful reading.

CARNEGIE-ILLINOIS STEEL CORPORATION
PITTSBURGH - CHICAGO

Pacific Coast Distributors: Columbia Steel Company, San Francisco. · *Export Distributors:* United States Steel Products Co., New York

UNITED STATES STEEL

TO RAILWAY SUPPLY MANUFACTURERS



It Won't go 'round

Expenditures for maintenance of way are increasing. They are running 25 per cent larger than in 1933—10 per cent ahead of last year.

Yet the accumulation of deferred work is so great that it cannot possibly be taken up this year. The best that can be expected is to meet the more pressing needs. Much work will be carried over.

Will your materials—your equipment—be included in this year's programs? Or will they be carried over until next year or the year following?

Do your products contribute to economy of railway maintenance? Have you a story to tell regarding their merits? Are you telling it to those maintenance officers who are preparing these programs and selecting the materials from day to day?

RAILWAY ENGINEERING AND MAINTENANCE IS READ BY MAINTENANCE OFFICERS OF ALL RANKS

"We're Not Interested In Your Patented Process. We Do Our Own Welding!"

...But that's just the point, Mr. Smith. You ARE interested in the Morrison Process . . . for you're using it today. And we want you to go right ahead and continue to do so.

Why not let us show you how to use this process to its best advantage . . . how to bring your methods up to date so that they may afford their utmost economies! Why not profit from the many things we've learned about reconditioning manganese track units through ten years of experiment, research and actual operation. This knowledge is available to you . . . without cost . . . in the MORRISON METALWELD SERVICE.

[*MORRISON METALWELD SERVICE is described in detail in a booklet which will be sent upon request.*]

MORRISON RAILWAY SUPPLY CORP.

BUFFALO, N. Y. CHICAGO, ILL.

MORRISON METALWELD PROCESS INC., a wholly owned subsidiary is equipped to do contract work in welded repairs to frogs, crossings and bridges . . . and building-up rail ends by electric arc or oxy-acetylene.

LUFKIN "Wolverine" Steel Tapes

Popular with Engineers and others requiring a sturdy tape for precise work.

The "Wolverine" is an engineers pattern 1/4 inch heavy line, readily detached from reel and supplied with improved pattern end rings.

Compact and substantial metal disk reel. Lock handle.

Send for Catalog

THE LUFKIN RULE CO. Saginaw, Mich., U.S.A., 106-110 Lafayette St., New York

RAILROAD CALCYANIDE IS EASILY APPLIED

in any type of structure; in a railroad car, because it is narrow, most easily of all—down the center aisle only, not both lengthwise and crosswise.

With other products insects and their eggs must be hit in order to be destroyed. With Railroad Calcyanide the powder liberates a gas that distributes itself uniformly throughout the entire car and penetrates wherever vermin are present. Only one application of Railroad Calcyanide is necessary for a complete kill of all insects and eggs.

CALCYANIDE COMPANY

60 E. 42nd St., New York City

Classified Advertisements

Use this section when seeking a new man, a new position, or when buying or selling second-hand equipment.

CLASSIFIED ADVERTISEMENTS, $10.00 an inch, one inch deep by three inches wide, an insertion.

EMPLOYMENT ADVERTISEMENTS, 10 cents a word a month, including address, minimum charge $2.00.

Remittance must accompany each order.

Railway Engineering and Maintenance
Classified Advertising Department
105 West Adams St., Chicago

Large manufacturing company with specialized sales force wants to increase diversification of its products and would take on manufacture and sale of additional railway specialties.

If you have a product that will justify quantity production we would like to talk to you.

Please give complete description of purpose, kind of machine, and its application.

All replies treated with strictest confidence.

Address Box 361, RAILWAY ENGINEERING AND MAINTENANCE, 105 West Adams St., Chicago, Ill.

STEEL DUMP CARS
Air Operated
Eight—20 yd. WESTERN, built 1929
Three—30 yd. CLARK, built 1923
Ten—10 yd. WESTERN, built 1927
In unusually good condition

IRON & STEEL PRODUCTS, INC.
Railway Exchange, Chicago
"Anything so long as it contains IRON or STEEL"

Sent on approval for 10 days' FREE examination.

226 pages, 44 illustrations, cloth 6x9 inches, $2.00 postpaid.

Your Best Bet

The thinking man never disregards the practical value of reading such books as "Roadway and Track." This book covers in a sentence facts that theorizing would stretch to a page.

This condensation has permitted the author to do what few have done previously—make the least demand upon the reader's time in giving him the meat of modern maintenance practice.

Your best bet is "Roadway and Track" if you want facts you can apply to your own work.

You may keep this book for 10 days' examination without cost.

Send for a copy today.

Simmons-Boardman Publishing Co.
"The House of Transportation"
30 Church Street New York, N. Y.

Permutit

Leading maker of boiler feed-water conditioning equipment now enters the field of

INTERNAL

Boiler Feed-Water Treatment

The operating conditions of many a plant make internal treatment the logical and satisfactory method for overcoming feed-water troubles. Here is news to these plants: Permutit *Internal* Boiler Feed-Water Treatment has now been developed as a specialized service, based on more than 20 years' experience in boiler feed-water conditioning. Note these three features of Permutit service.

1—*Correct Chemicals.* We analyze your water supply and make a personal "prescription" of the chemicals your plant needs.

2—*Correct Feeding Equipment.* We recommend and install the proper equipment for feeding the chemicals so as to assure proper dosage for your operating conditions.

3—*Service and Maintenance.* Constant check-ups of operation are made by our technical field organization, and by our home office and laboratory staffs.

Get full information about this new service. Write for illustrated booklet that explains in simple language just how Permutit Internal Treatment benefits your boiler plant.

The Permutit Company, 330 West 42nd St., N. Y. C.

WATER-PROOFING *with* Sika

1 Original surface hacked.
2 Water concentrated to enlarged bleeder holes by Sika #4A.
3 Two bleeder holes plugged by Sika #2. Infiltrations concentrated to bleeders.
4 Inserting Sika #2 into last bleeder hole.
5 All bleeder holes plugged with Sika #2, and trimmed to contour.
6 Protective coat of Sika #2 cement plaster applied.

Use Sika to stop water inflow through any masonry. Sika mixed with portland cement easily applied by hand — seals off infiltration from underground streams even under pressure.

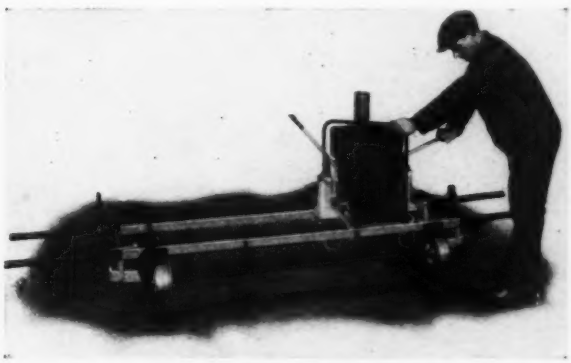
Write us about your problems

Sika, Inc.
1943 Grand Central Terminal, N. Y. City

Model P-22, Portable Flexible Shaft Grinder
Gasoline engine driven free hand grinder operating either a cup or straight grinding wheel for grinding surface welded joints, crossings, frogs, switch points and stock rail. One of many models.

The more you spend for rail welding

the more important it becomes to choose your grinding equipment with care. Grinding cost is the only true measure of equipment value. Whatever your standards, whatever your requirements or ideas, you will find that the wide line of Railway Track-work Rail Grinders includes what you want. To verify this, write for a set of the latest data bulletins.

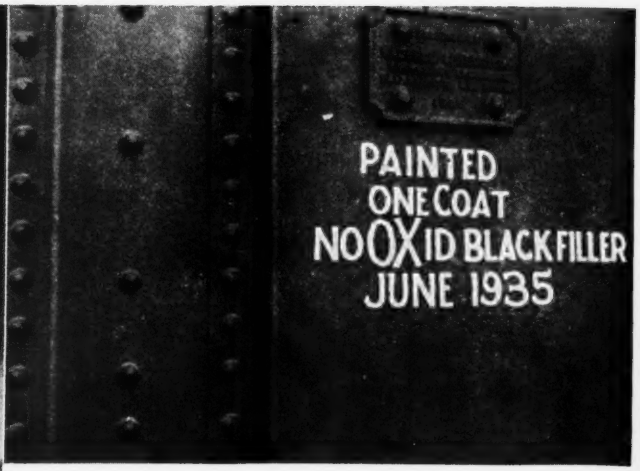


Model P-11, Rail Joint Cross Grinder
A portable cross grinder for removing overflowed metal from rail ends and slotting closed and welded joints. This machine, owing to certain mechanical features, attains high production, accuracy, efficiency and economy.

Railway Track-work Co.
3132-48 East Thompson St., Philadelphia

WORLD'S HEADQUARTERS FOR TRACK GRINDERS

6073



Economy in Maintenance

The use of NO-OX-ID does away with expensive cleaning methods for bridges, tanks and other steel structures. One coat often gives eight years and even longer protection. The savings effected permit a 60% increase in maintenance work without budget increases. This is the most decided economy ever developed in maintenance work. It is yours for the asking. Facts and figures supplied gladly.

DEARBORN CHEMICAL COMPANY

310 S. Michigan Ave., CHICAGO 205 East 42nd St., NEW YORK
Canadian Factory and Offices: 2454-2464 Dundas St., W., Toronto

ALPHABETICAL INDEX TO ADVERTISERS

A

Air Reduction Sales Co. 328
Armco Culvert Mfrs. Assn. 274-275

B

Barco Manufacturing Company 279
Bethlehem Steel Co. 272-273

C

Calcyanide Company 324
Carnegie-Illinois Steel Corp. 321
Columbia Steel Co. 321

D

Dearborn Chemical Company 326

E

Eaton Manufacturing Co. 266

F

Fairmont Railway Motors, Inc. 269

I

Ingersoll-Rand Co. 276-277
Ingot Iron Railway Products Co. 274-275

L

Lufkin Rule Co., The 324
Lundie Engineering Corporation, The 267

M

Master Builders Co., The 278
Metal & Thermit Corporation 271
Morrison Railway Supply Corp. 323

N

National Lead Company 327
Nordberg Mfg. Co. 270

O

Oxweld Railroad Service Company, The 281

P

Permutit Co., The 325

R

Rail Joint Company, The 265
Railway Track-Work Co. 325
Ramapo Ajax Corporation 284-285

S

Sika, Inc. 325
Simmons-Boardman Pub. Co. 322-324

T

Technical Coatings, Inc. 281
Timken Roller Bearing Company, The 268
Toncan Culvert Mfrs. Assn. 319
Truscon Steel Company 286

U

United States Steel Corporation Subsidiaries 321
United States Steel Products Co. 321
Union Carbide and Carbon Corp. 282

W

Woodings Forge and Tool Co. 317
Woodings-Verona Tool Works 317

THERE'S a way to stop rust from robbing metal of its life. Paint metal surfaces with Dutch Boy Red-Lead. Then you can be sure they are protected against "rust—the robber."

Paint made with Dutch Boy Red-Lead provides a solid, tough, tenacious coating—one that not only keeps out rust-forming moisture but also resists the destructive action of other common causes of corrosion, such as gases, smoke and salt water.

Dutch Boy Red-Lead comes in both paste and liquid form, the latter including a quick-drying type for use when allowable drying time is short. The pigment in every case is pure red-lead that contains more than 97% Pb_3O_4, thus assuring easier application, higher spreading rate, and a uniform film of greater density.

For complete information on protecting iron and steel against corrosion, send for our free booklet, "Structural Metal Painting." It covers such subjects as conditions affecting the life of paint on metals, proper paint formulation, testing and judging the value of paint, estimating areas and costs.

...for sure protection use

DUTCH BOY RED-LEAD

NATIONAL LEAD COMPANY

111 Broadway, New York; 116 Oak Street, Buffalo; 900 W. 18th Street, Chicago; 659 Freeman Avenue, Cincinnati; 820 W. Superior Avenue, Cleveland; 722 Chestnut Street, St. Louis; 2240 Twenty-fourth Street, San Francisco; National-Boston Lead Co., 800 Albany Street, Boston; National Lead & Oil Co. of Penna., 316 Fourth Avenue, Pittsburgh; John T. Lewis & Bros. Co., Widener Building, Philadelphia.

AIRCOWELDING *and* AIRCO EQUIPMENT *will help cut track maintenance costs*

Modern streamlined speed demands perfect trackage. It emphasizes the importance of track maintenance and increases the need for building up and heat treating rail ends. It follows that the cost of these operations must be watched more closely than ever.

AIRCOWELDING, the easier, faster building up process, AIRCO-DB Torches, Multi-flame Tips and Two-stage Reduction Regulators—individually and together they assure lower building up and heat treating costs because they embody exclusive time-labor-and-gas-saving features.

Airco Railroad customers have reduced their maintenance costs to a minimum through the combination of AIRCO apparatus, oxygen and acetylene, and Engineering Assistance.

AIR REDUCTION SALES CO.

General Offices: 60 East 42nd St., New York

DISTRICT OFFICES and DISTRIBUTING STATIONS in PRINCIPAL CITIES

A NATION-WIDE WELDING and CUTTING SUPPLY SERVICE